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OF THE

New England Water Works ASSOCIATION.

1891-92.

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ERRATA.

Vol. V., page 10, tenth line, for "brickkiln" read "ravine."

NEW ENGLAND WATER WORKS ASSOCIATION.
ORGANIZED 1882.

Vol. VI. September, 1891. No. 1.

This Association, as a Body, is not responsible for statements or opinions of any of its members.

PROCEEDINGS OF THE TENTH ANNUAL CONVENTION,
Hartford, Conn., June 10, 11 and 12, 1891.

The sessions of the Tenth Annual Convention of the Association were held in Putnam Phalanx Hall on Wednesday afternoon and evening, June 10th, and on Thursday morning, afternoon and evening, June 11th. The meetings were well attended, and the interest in the proceedings, considering the intense heat, was well sustained. President Noyes presided, and vocal music was rendered at intervals during the meetings by Messrs. Pratt and Munroe, of Cambridge. In rooms adjoining and connected with the convention hall was an exhibit of water works appliances by the associate members.

AFTERNOON SESSION.

WEDNESDAY, JUNE 10, 1891.

The President introduced the Hon. Henry C. Dwight, Mayor of Hartford, Conn., who spoke as follows:

ADDRESS OF WELCOME BY MAYOR DWIGHT.

Mr. President and Gentlemen of the New England Water Works Association:—Some time ago I was requested by the Hon. Ezra Clark, president of our efficient Water Board, to come in to your meeting when you should assemble and speak a few words of welcome. It is a pleasant duty that the Mayor of the city of Hartford often has, to welcome to our city and to our pleasant ways members of many different associations, but I know of none in the world today that has more important interests committed to it, and bears a more important part in its relations to the health and welfare of the community, than the Association which you represent here. And I say this, that while it is a matter of experiment to a very large extent in certain ways, I hope before you leave you will go out to our beautiful reservoirs and see the wonderful supply of water we have there, which, I think, is the most permanent, and probably the most successful system of ponded water works in the

United States today. We in Hartford are apt to think a good deal of ourselves. I am not a native of Hartford, though a New England man born and bred, but as the official representative of our citizens it gives me pleasure to welcome you to this city of my adoption. And I say to you that there is no more beautiful spot on the face of the earth than this city in which you are now assembled. It has historical reminiscences, and it has historical stories, being one of the oldest places in the country. Though we sometimes in New England are called pretty slow as compared with some places in the wild and woolly West, still, I think if we should be in the West, as it has been my fortune to be, we would find the eyes of the western people are upon New England to-day, as they have been in the past, and that New England is still the chief place for the development of all of those things which make up the welfare and benefit of mankind. (Applause.)

I know it is said, and was said sometimes in the army when I was there, that water is a grand good thing for navigation. Hartford has very little use of water for navigation. Our water is for domestic and manufacturing purposes, and that is what it is used for to a very large extent. I presume those who founded this place 200 years ago founded it upon this spot because, among other things, it was on the bank of the Connecticut; and in the early days the river answered very well for the purposes of navigation. But as the railroad was introduced with its facilities, and as the city grew, the river ceased to be used for the purposes of navigation and was used as a water supply for the citizens. But gradually the water became so affected by the sewage and the changes which were going on by the growth of population and the introduction of manufactories that a new supply became needed. And so in the wisdom of the men who had this matter in charge our present system of ponded water was arranged for, at an estimated cost of some $250,000. That was thought by many people to be a large sum of money to be expended in an experiment; but the system has already cost nearly two millions of dollars. I believe if the original proposition had been made to the citizens of Hartford to put in this system at the cost of two millions of dollars, they would all have run away from the meeting and gone home and got under their beds, they would have been so frightened at the idea of such an expense. But still since it has been in use, which is only a few years, since I have been a resident of Hartford, it has paid its way, it has paid the interest on this immense sum of money, it has paid a part of its debt, until at the present time, I think, the debt has been reduced to $752,000. And we have gone on enlarging the system, so far as the distribution is concerned, and the rates charged in Hartford are as low as they are in any other place in New England, perhaps lower.

I think it is a good thing that you have come down here, and are to examine into matters which relate to water supply, that you may see our system here, and that you may talk over matters and confer with each other upon these topics which affect so vitally the welfare of mankind. This seems to be an age of associations. There used to be a man up in Northampton, where I lived when I was a boy, who said he was bound to join something, a church or a fire company, he didn't know which. It seems to be the thing nowadays for men to join themselves together in associations, and I think it is a good thing

for them to thus unite the different departments which they live in. I say "live in," for I believe that in our country if a man is, for instance, the president of a Water Board, or is an officer in the Water Board, he lives in that Board. It is a peculiarity of the American people that if we get into any business we live in it. And probably it seems to you, gentlemen, who are engaged in this work of supplying water to cities, that there is nothing else in this world to think about except water—water to drink and water to give to other people to drink. Well, those of us who "are not in it" are perfectly willing to leave it right in the hands of you gentlemen who know all about it; we are perfectly willing you should take charge of it. And I hope, after you have looked into our system, if you can make any suggestions that will benefit us, you will make them freely, because advice is about the cheapest thing that I know of in this world. It is freely given and generally it is very freely accepted—whether it is acted on is another matter. As Mayor of the city of Hartford I advise a great many things, but a great deal of it is not acted on.

I think it is a most excellent thing that you are associated together to do. A man may build a great monument, a man may build a wonderful piece of architecture, but still if there is a flaw in one single stone it may come down. You gentlemen may perform a great deal of work in the line of the water supplies for your different cities, but if there is one flaw in the system the water may not be good, may be rendered impure; and in these meetings you can talk it over, and see what the matter is. It is a good thing for you thus to associate together, and rub up against each other, and find out that there are some men who know more than you do about certain things after all.

I have made a longer speech than I had expected. It is a real pleasure to me as Mayor of this city of Hartford to see you here. It is a real pleasure at any time to have gentlemen come up to this city of ours singly or in associations when they have the benefit of their fellow men in mind. I do not know as men ever get their full recompense in this world for what they do for their neighbors; in fact, I have grave doubts if we are ever fully compensated here for what we do for others. And, yet, I tell you I believe more and more every day that it is a great deal better for us to do what we can for our neighbors and for the benefit of the men and women about us, than to do what we can for ourselves. And so it is a blessed thing in this New England government of ours, established on the foundation that it was, that it is the people who govern; and that we who occupy, temporarily perhaps, positions of trust, are expected by our birth, by our education, by the life we live here, to do our duty everywhere and every day, and let God take care of the rest. Welcome to Hartford, gentlemen, with all my heart. And when you have looked about here, if you see anything you think will be of benefit to us, we will thank you for your advice concerning it, and if there is anything we can show you that will be of interest or of education or of pleasure to you, let us know what it is. Our hands are extended to you, our hearts are with you, and may God bless you wherever you go. (Applause.)

THE PRESIDENT. Mr. Mayor, in behalf of the New England Water Works Association I have to thank you for your kind welcome to us. As you have said, our Association is composed of officers of the various water works of

New England and other States of this country, largely of New England, who have to deal with the practical questions of management and construction. Our Association has now grown to be so large that the smaller cities and towns hardly furnish sufficient accommodations for our annual gathering, so that it has become necessary for us to select the larger cities; and we have come to your city knowing the ample accommodations here, and the beauties of your city and the interesting features of your works, as you have already described them.

Before proceeding to the business of the convention I will state that we have with us here to-day one of the pioneers in water works management, a gentleman who has been identified with the Hartford Water Works since the year 1854, who has represented this district in Congress two terms with honor, and whose name is known throughout New England. I know it will give you all pleasure to hear a few words from him. I have the pleasure of presenting the Hon. Ezra Clark, President of the Hartford Water Board.

MR. CLARK. Mr. President, I am very much taken by surprise, for I did not come here to make a speech. I think our worthy Mayor has said all that is necessary, and I wish you would excuse me from saying anything. Of course I am very glad to see you here, and if there is anything I can do to make your stay here a pleasant one I shall be very happy to do it.

THE PRESIDENT. Mr. Clark, in behalf of the Association I thank you. We deeply appreciate your kindness.

The convention then proceeded to the regular order of business.

On motion of the Secretary the reading of the records of the last meeting, they having appeared in print, was dispensed with.

ELECTION OF NEW MEMBERS.

The Secretary then read the following list of candidates for election to membership in the Association:

RESIDENT ACTIVE MEMBERS.

J. Allen Butler, Superintendent, Portland, Conn.
George A. P. Buckman, Superintendent, Norwood, Mass.
John L. Congdon, Superintendent, East Greenwood, R. I.
W. P. Ellison, President Water Board, Newton, Mass.
A. R. Hathaway, Water Registrar, Springfield, Mass.
S. P. Griffin, Superintendent, Lowell, Mass.
Francis Hunnewell, Commissioner and Registrar, Brookline, Mass.
Edward C. Nichols, Commissioner, Reading, Mass.
Richard Baldwin, Proprietor Water Works, Terryville, Conn.
William P. Swett, Proprietor Water Works, Terryville, Conn.

NON-RESIDENT ACTIVE MEMBERS.

Milton A. Brown, Superintendent, Perth Amboy, N. J.
Edward W. Hart, General Manager, Council Bluffs, Ia.
Edward Dolan, Superintendent, Troy, N. Y.
William D. Pollard, Engineer Water Co., Pottsville, Pa.

ASSOCIATE MEMBERS.

John E. Lynch with E. Hodge & Co., constructors of standpipe, East Boston.
Holly Mfg. Co., pumping engines, Lockport. N. Y.

On motion of Mr. Richards the Secretary was authorized to cast the ballot of the Association for the applicants whose names had been read, which he did, and they were declared elected members of the Association.

ADDRESS OF THE PRESIDENT.

President Noyes then addressed the convention as follows:

Gentlemen of the New England Water Works Association:—We have now assembled to hold our tenth annual convention in this city, the capital of the State of Connecticut—our first meeting in this State. We have come to consult together and to discuss the various topics of interest and importance in the management of water works, and to gain that fund of information which can only be obtained by meeting together and comparing the experience of each in the management of our respective works. The history of the Association is known to most of you here, and it is with feelings of pride that we refer to its humble beginning, its growth, and influence it has had in extending information upon all questions pertaining to water works management. From a meeting of 21 water works superintendents and registrars, holden at Young's Hotel, Boston, April 19, 1882, there has grown an association having a membership of 360, divided as follows:

Active members, 281; Honorary members, 5; Associate members, 74; an increase of 25 members during the past year. With the increase in membership of the association, the work and responsibilities of the executive officers, especially those of the secretary and editors of the Journal, have increased to such an extent as to demand a large portion of their time in order to keep the records and journal up to their highest standard. While this service has been willingly and faithfully performed in the past, I feel that the compensation for it should be such as to enable them to give the time and personal attention the character of the work requires.

There has been a growing feeling among many of the members that the association should have permanent headquarters, where the members could be welcome at all times to meet each other, or to transact business, and where samples of the goods of the associate members can be exhibited.

From the report submitted by the treasurer, which will soon be read, it will be seen that there is in the treasury the sum of $2,299.65; deducting bills which have been contracted for, and not paid, will leave in the treasury about $2,000, an increase in the funds of the association of about $900 during the past year. And it would appear that this association will soon be financially able to maintain such headquarters, thus extending its influence and increasing its usefulness. I would recommend that a committee be appointed at this convention to consider and report at some subsequent meeting upon the expediency of establishing headquarters, and a plan for the same.

During the past year the interest in the meetings has continued unabated—the December meeting being continued by adjournment through each of the winter months, the reading of short, experience papers being made one of the leading features. There are still numerous questions pertaining to the management and welfare of water works which remain unsettled, and upon which study and discussion can be made to advantage.

During the past year we have lost by death from our membership Mr. F. Floyd Weld, late city engineer of Waterbury, Conn., and Mr. Benjamin Grush, late superintendent of the Salem (Mass.) Water Works. Each, while in good health, and able to perform the duties of their office, were efficient and faithful officers. They were always warm-hearted and kind friends, and by their death the association suffers a loss. It is with a feeling of regret that I have to announce the determination of Mr. Albert S. Glover, Junior Editor, not to become a candidate for re-election to that office. To his intelligent management the success of the journal is largely due, but in losing his services officially I am assured that the officers of the association will have his willing assistance.

In closing, I desire to thank you for the honor you have conferred upon me, and the confidence thereby imposed, in selecting me to preside over your meetings as president. Whatever of success may have attended the meeting, is due to the united efforts of the officers and members. I predict for this association a future equal to that of any association or society in the country, but we must ever keep in mind that the highest degree of usefulness can be obtained only by the hardy and willing co-operation of every member, each doing his share.

The Secretary then submitted the following:

ANNUAL REPORT OF THE SECRETARY.

NEW ENGLAND WATER WORKS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., June 1st, 1891.

TO THE MEMBERS OF THE NEW ENGLAND WATER WORKS ASSOCIATION:

Gentlemen—Your secretary herewith presents his report for the year ending June 1st, 1891:

On June 1st, 1890, the membership of this Association was as follows, viz:

Active members	257
Honorary members	5
Associate members	73
Total	335

During the past year there has been a loss of 18 members from the following stated causes:

Resignations	15
Deceased	2
Suspended for non-payment of dues	1

Forty-three applications for membership have been presented for your consideration, all of which have received favorable action.

The membership at this date is—

Active members	281
Honorary members	5
Associate members	74
Total	360

The net gain for the year has been 25 members.

Your Secretary has made 409 collections, which may be thus itemized:

From advertisements	$1,500.00
" initiation fees	256.00
" dues	1,159.50
" sale of transactions	102.84
Total	$3,018.34

All of which has been paid to the Treasurer.

Respectfully submitted,

R. C. P. COGGESHALL, Secretary.

On motion of Mr. Richards the report was accepted.

THE PRESIDENT. We regret to-day that our Treasurer, Mr. Nevons, cannot be here to read his report, being confined to the house with a severe illness. The Secretary will read the report.

ANNUAL REPORT OF THE TREASURER.

Mr. President and Gentlemen: I herewith submit my report, as Treasurer of the New England Water Works Association, for the year ending June 10, 1891:

1890.	RECEIPTS.	
	Cash on hand June 11, 1890	$1,105.01
June 12.	Received from R. C. P. Coggeshall	266.00
Sept. 29.	" " " "	600.00
Nov. 19.	" " " "	800.00
1891.		
Jan. 13.	" " " "	600.00
Mar. 16.	" " " "	400.00
June 1.	" " " "	352.34
	Accrued interest to date	61.08
		$4,184.43

EXPENDITURES.

June	13.	By Payment to	Proprietor Falmouth House, Portland	$18.00
"	20.	" "	Charles R. Dyer, services	14.54
"	20.	" "	J. W. Black & Co., illustrating Lecture	20.75
"	25.	" "	Hiram Nevons, Treasurer, stationery	4.75
July	23.	" "	Walter Rogers & Co., reporting	95.00
Aug.	5.	" "	A. S. Glover, expenses	11.00
Sept.	13.	" "	J. M. Whittemore & Co	4.00
"	29.	" "	A. S. Glover, services and stationery	79.30
"	29.	" "	Rockwell & Churchill, printing	30.57
Nov.	19.	" "	" " "	211.30
Dec.	10.	" "	R. C. P. Coggeshall, salary and expenses	281.12
"	10.	" "	Mercury Publishing Co., printing	82 36
"	10.	" "	Francis L. Pratt, music	15.00
"	10.	" "	J. R. Whipple, lunch	15.50
"	30.	" "	A. S. Glover, salary	75.00
"	30.	" "	W. N. Hughes, printing	7.75
"	30.	" "	Forbes Lithograph Co	19.50
1891.				
Jan.	13.	" "	Charles H. Stacy, postage and express	3.23
"	14.	" "	J. R. Whipple, cigars and lunch	16.00
"	14.	" "	F. L. Pratt, music	15.00
Feb.	15.	" "	Edwin Dews, binding reports	8.25
"	15.	" "	F. L. Pratt, music	15.00
"	15.	" "	J. R. Whipple, balance on dinner	14.50
Mar.	4.	" "	A. S. Glover, services	75,00
"	17.	" "	J. M. Whittemore, envelopes	8.00
"	11.	" "	J. R. Whipple, Young's Hotel	16.50
"	17.	" "	F. L. Pratt, music	15.00
Feb.	2.	" "	Forbes Litho. Co.	22.00
"	28.	" "	Rockwell & Churchill	89.96
"	28.	" "	Walter Rogers & Co	77.50
May	20.	" "	Charles H. Stacy, stationery	12.57
June	2.	" "	R. C. P. Coggeshall, salary and stationery	272.47
"	2.	" "	Mercury Publishing Co., stationery	131.60
"	2.	" "	Robert W. Taber, stationery	3.31
"	2.	" "	Walter T. Almy, badges	10.80
"	4.	" "	Albert S. Glover, services and stationery	82.65
"	4.	" "	S. J. Vose, typewriting	10.00
"	11.	By balance on hand at close of year.	Nat. City Bank	1,138.57
			Cambridge Sav. B'nk.	100.00
			Cambr'p't Sav. B'nk.	1,000.00
			Accrued interest to date	61.08
				$4,184.43
			Balance on hand	$2,299.65

Respectfully submitted,

HIRAM NEVONS,

Treas. N. E. W. W. Association.

Approved: H. F. WHITTIER, Finance Committee.

The report was accepted and ordered placed on file.

The President appointed the following committee to collect and distribute blue prints: George F. Chace, F. H. Crandall, Walter H. Richards.

COMMUNICATIONS.

The Secretary read a communication from J. M. Diven, President of the American Water Works Association, requesting the co-operation of the New England Association in investigating the Vegetable Growths which affect water supplies.

On motion of Mr. Brackett the communication was referred to the Executive Committee with full power to take such action as they may deem necessary.

A commuication was read from F. A. W. Davis, Vice President of the Indianapolis Water Co., requesting the consideration of the feasibility of organizing a Waste Prevention Company.

On motion of Mr. Richards the Secretary was directed to reply that action on the matter was not in the province of this Association.

The Secretary read communications from the Holyoke Board of Trade, in behalf of the citizens and manfacturers of Holyoke, extending a cordial invitation to the Association to make that city the place of its next annual meeting; and from E. S. Waters, Treasurer of the Holyoke Water Power Co., Lewis E. Bellows, agent of the Deane Steam Pump Mf'g. Co., J. S. McElwain, agent of the Parsons Paper Co., F. B. Towne, Treasurer of the National Blank Book Co., and H. J. Frink, agent of the Holyoke Machine Co., all heartily joining in the invitation of the Board of Trade.

On motion of the Secretary the communications were laid upon the table until the regular time for consideration of this subject at the Thursday morning session.

The committee appointed at the last convention to consider the standing of active and associate members reported through the Secretary, and the report was referred to the Executive Committee.

The first paper of the session was then read by Freeman C. Coffin, of Boston, upon the subject, "Standard Flanges for Water Pipes." After remarks upon the subject of the paper by Mr. Meyer and Mr. Allis, the convention adjourned until evening.

EVENING SESSION.

At the opening of the evening session the Secretary read a letter from the Pratt & Cady Company, extending an invitation to the members of the Association to visit their works.

The Secretary, in the absence of the author, then read a paper prepared by Mr. E. E. Farnham, Superintendent, Sharon, Mass., entitled "An Experience with a Water-Hammer." Mr. Gould, Mr. Brackett, the President, Mr. Whitney, Mr. W. M. Hawes and others took part in the discussion which followed the reading of the paper.

The convention next listened to a paper by H. G. Holden, Superintendent, Nashua, N. H., entitled "Are Lead Pipe Connections for Iron Service Pipe

Desirable?" The subject was discussed by Mr. Codd, Mr. Richards, Mr. Allis, Mr. Holden, Mr. Gow, Mr. Stacey, Mr. Brackett, Mr. Coffin, Mr. W. E. Hawes, Mr. Coggeshall, Mr. Whitney, Mr. Meyer and Mr. Milne. At the close of the discussion the convention adjourned to 9 A. M. Thursday morning.

THURSDAY, June 11, 1891.

MORNING SESSION.

The first business in order at the Thursday morning session was the report of the nominating committee which, in the absence of Mr. Hall, who had been called out of the city, was read by the Secretary. The committee recommended the election of the following named officers of the Association:

OFFICERS, 1891-92.

President—Horace G. Holden, Nashua, N. H.

Vice-Presidents—George F. Chace, Taunton, Mass.; Charles K. Walker, Manchester, N. H; F. H. Crandall, Burlington, Vt.; Henry W. Ayres, Hartford, Conn.; Byron I. Cook, Woonsocket, R. I.; Charles R. Dyer, Portland, Maine.

Secretary—R. C. P. Coggeshall, New Bedford, Mass.

Treasurer—Hiram Nevons, Cambridgeport, Mass.

Senior Editor—Dexter Brackett, Boston, Mass.

Junior Editor—Walter H. Richards, New London, Conn.

Executive Committee—Frank E. Hall, Quincy, Mass.; Albert F. Noyes, West Newton, Mass.; Charles W. Morse, Haverhill, Mass.

Finance Committee—H. F. Whittier, Lawrence, Mass.; G. E. Winslow, Waltham, Mass.; F. A. Andrews, Nashua, N. H.

On motion of Mr. Glover the report of the nominating committee was accepted.

On motion of Mr. Clark of Hartford the Secretary was requested to cast the ballot of the Association for the nominees, which he did, and they were declared elected.

MR. HOLDEN. Mr. President and gentlemen of the New England Water Works Association, I thank you most heartily for the honor which you have seen fit to confer upon me, and I shall endeavor, with the co-operation of all the members, to keep the Association up to the standard which it has already attained. (Applause.)

THE PRESIDENT. Mr. Holden, I feel that I can voice the opinion of every member of this Association when I say it is the unanimous wish of the Association that you serve us, as expressed in the work of the nominating committee, and in the action which we have just taken. I think I am free to say that whenever the question has come up who should be our next President, our minds have turned instinctively towards you, one of our oldest members, one of the first in organizing the Association, and one who has been ever ready to do his part in carrying it on. And I know I can say that you will have the support of every man here to make the year's work a success. (Applause.)

THE PLACE FOR THE NEXT CONVENTION.

The Secretary, after remarking that it seemed as if the whole of Holyoke wanted the convention to be held in that city next year, referring to the urgent invitations which had been received at the Wednesday afternoon session, read additional letters from the Holyoke Steam Boiler and Iron Works, and from the proprietors of the Hotel Hamilton, the latter offering the free use of Hamilton Hall for the meetings of the convention. The communications were placed on file.

On motion of Mr. W. E. Hawes it was voted that the next annual convention be held at Holyoke.

PERMANENT HEADQUARTERS.

MR. GLOVER. If it be in order at this time I wish to make a motion that a special committee of five be appointed to take into consideration and to report at some subsequent meeting of the Association, the recommendation of the President in regard to permanent headquarters.

The motion was adopted, and the President subsequently appointed the following gentlemen to constitute the committee: Albert S. Glover, George E. Batchelder, John R. Freeman, Frank E. Hall and Desmond FitzGerald.

The convention then listened to a paper by J. E. Hancock, Superintendent, Springfield, Mass., on "The Risks Taken by a City or Town in Having but One Supply Main." The paper was discussed by Mr. Richards, Mr. Hawes and Mr. Taylor.

The Secretary read a communication from Mr. S. E. Babcock, apologizing for his failure, due to illness, to prepare a paper.

Mr. J. C. Whitney for the committee on Classification of Rates presented a report which was discussed by Mr. Billings, Mr. Meyer, Mr. Holden, The President, Mr. Allis, Mr. Beals, Mr. Brackett, Mr. Hawes and Mr Taylor. On motion of Mr. Hawes extra copies were ordered printed for each member.

Mr. George F. Chace, Superintendent of Taunton, Mass., read a paper entitled, "Three Years Experience With a Direct Pumping System," which was discussed by Mr. Freeman, Mr. Billings, Mr. Chase and Mr. Allis.

The President announced the presence of representatives of the Connecticut Society of Civil Engineers and Surveyors, and introduced its President, Mr. Auger, who addressed the convention.

MR. AUGER. Mr. President and gentlemen, it is hardly fair I should take any of your time this morning, as your programme is so full. I will simply thank you for your cordial invitation to the members of our Association to meet with you at this time and to participate in these exercises. Quite a number of the members of our Association are members of your Association also, and they are present. Our Association is not so largely represented here as we had hoped it might be, owing to the fact that many of us, being engaged in city and other work, are detained at home. Again I thank you for the courtesy you have extended to us, and assure you that we are pleased to accept your invitation to be present with you.

TOPICAL DISCUSSION.

The President announced the topic, "What is the Minimum Size of Main Allowable for Water Supply?" which was discussed by Mr. Brackett, Mr. Freeman, Mr. Fuller, The President, Mr. Whitney, Mr. Taylor and Mr. Coffin, and the topic, "To What Extent is the Use of Water Meters Advisable?" which was discussed by Mr. Whitney and Mr. Chace.

COMMITTEE ON BADGES.

On motion of the Secretary it was voted that the President appoint a committee to consider the question of a badge for the Association, and to report at some subsequent meeting.

The convention then adjourned to 2.15 P. M.

AFTERNOON SESSION.

The convention met pursuant to adjournment. The President appointed the following committee on badges: Dexter Brackett, William R. Billings and F. W. Whitlock

Mr. Lucian A. Taylor, civil engineer, Boston, Mass., addressed the convention, and gave a description of the New Haven Water Company's dam at Woodbridge, Conn.

Mr. F. F. Forbes, Superintendent, Brookline, Mass., read a paper entitled, "The Relative Taste and Odor Imparted to Water by some Algæ and Infusoria, and Thoughts Suggested by Studies in this Direction."

TOPICAL DISCUSSION.

The topic "Is it Desirable that the Whole Supply to a Large Factory Should be Metered, or Should the Fire Service be Separated from the Domestic Service?" was discussed by Mr. Freeman, The President, Mr. Coggeshall and Mr. Cook.

The President announced that Mr. Chase, the Secretary of the Hartford Water Company, had arranged for a trip to the Capitol, and the convention then adjourned to 7.30 P. M.

EVENING SESSION.

At the opening of the evening session the President called attention to the fact that no arrangements had yet been made for the fall meeting of the Association; and on motion of the Secretary the matter was referred to the Executive Committee with full power.

Mr. Chace, for the Committee on Blue Prints, submitted the following report: "The following diagrams are offered for distribution:

Chimney at Pumping Station, New Bedford Water Works, R. C. P. Coggeshall.

Diagram of Rainfall and Level of Reservoir, Norwich, Conn., by C. E. Chandler.

Plan of Force Main Connections, Taunton Water Works, by Geo. F. Chace.

Plan of Valve and Cock Wrench Rack, Cambridge, Mass., by John L. Harrington.

Of these there are 28 full sets."

TOPICAL DISCUSSION.

The topic, "What is the best form of House Inspection of Fixtures," was discussed by Mr. Hathaway, of Springfield, Mr. Allis, Mr. Chase, Mr. Winslow, Mr. Holden, Mr. Beals, and Mr. Coggeshall.

The topic, "Should Metres be Owned by the Water Takers," was discussed by Mr. Whitney and Mr. Whitlock.

The topic, "Service Pipes," was discussed by Mr. Richards, Mr. Coggeshall, Mr. Philbin, Mr. Winslow, Mr. Beals, Mr. Chace, Mr. Fuller, Mr. Tenney and the President.

Mr. Walker inquired if any one knew of a better way to take out a pipe than melting out the joint, and Mr. Allis stated that he had cut the lead out with chisels, though the process was slow.

In response to an inquiry by Mr. Winslow as to the advantages of rocking grates, Mr. Allis spoke of the advantages of the Dillingham grate, and Mr. Gould, Mr. Codd and Mr. Coggeshall stated that they had used the Bannister rocking grate with success. Mr. Coggeshall stated that he was about to try a Cone grate.

Mr. Codd asked if, where brass feed and blow-off pipes were tapped into the shell of a boiler, there was any galvanic action to the detriment of the iron. Mr. Ross, being called upon by the President, stated, that in the opinion of naval engineers, the action took place only when salt water came in contact with it. Mr. Winslow thought that the action took place in fresh water as well.

On motion of Mr. Walker, put by the Secretary, the thanks of the Association was tendered to the retiring President for his services during the past year.

THE PRESIDENT. Gentlemen of the Association, I deeply appreciate this vote of thanks that you have tendered to me, particularly because I trust from your expression it is not merely a formal vote, but that you all, as Mr. Walker says he does, mean it. It has been a great pleasure for me to serve you in the humble way in which I have been able to in doing what little I could do to advance the interests of the Association. I believe the good this Association is doing is equal to that accomplished by almost any association I know of. The work of Water Works construction, maintenance and management is more concentrated and limited in its sphere than that in almost any other

professional or scientific pursuit. The ordinary engineering work is divided into so many different branches that the engineers cannot get so closely together in their organization as we do in ours. It is with a feeling of pride that I can say I am a member of the New England Water Works Association. Thanking you again for your kindness, I will now surrender my position to my successor, Mr. Holden.

Mr. Holden took the chair.

THE SECRETARY. In recognition of the courtesies which have been tendered us by the kind people of Hartford, I move a vote of thanks to President Clark, the Water Board and its officers.

The motion was adopted by a rising vote.

The members of the convention joined in singing "Auld Lang Syne," after which the convention dissolved.

On Saturday morning, through the courtesy of the Hartford Water Board, the members took barges for a ride to the reservoirs, and after a very enjoyable trip returned in time to take the afternoon trains out of the city.

LIST OF EXHIBITS BY ASSOCIATE MEMBERS AT THE CONVENTION.

Chapman Valve Manufacturing Co., Indian Orchard, Mass., Gates, Valves and Hydrants.

Peet Valve Co., Boston, Mass., Gates and Valves.

Taunton Locomotive Manufacturing Co., Taunton, Mass., Stop Boxes and Lead Melting Furnace for Pipe Laying.

Walworth Manufacturing Co., Boston, Mass., Tapping Machines, Valves, &c.

Perrin, Seamans & Co., Boston, Mass., Contractors' Supplies.

Standard Thermometer Co., Peabody, Mass., Electric Indicating and Recording Gauges.

H. R. Worthington, New York, Water Meter.

Holyoke Hydrant and Iron Works, Holyoke, Mass., Hydrants.

National Meter Co., New York City, Water Meters and Gas Pumping Engine.

Smith & Anthony Stove Co., Boston, Mass., Pipe Band for Tapping Cement-Lined Iron Pipe.

E. B. Williams, of Fairbanks, Brown & Co., Boston, Pratt and Cady Valves and Fittings.

George Ross, of Ross Valve Co., Troy, N. Y., Valves and Organ Blower.

Thomson Meter Co., New York, Water Meter.

Deane Steam Pump Co., Holyoke, Mass., Photographs of Pumping Machinery.

ATTENDANCE AT CONVENTION HELD IN HARTFORD, JUNE 10, 11 AND 12, 1891.

ACTIVE MEMBERS.

S. M. Allis, of Malden, Mass.
H. W. Ayres, of Hartford, Conn.
R. C. Bacot, Jr., of Hoboken. N. J.
Richard Baldwin, of Terryville, Ct.
J. E. Beals, of Middleboro, Mass.
W. R. Billings, of Taunton, Mass.
G. H. Bishop, of Middletown, Conn.
Dexter Brackett, of Boston, Mass.
J. C. Broatch, of Middletown, Conn.
M. A. Brown, of Perth Amboy, N. J.
J. A. Butler, of Portland, Conn.
C. E. Chandler, of Norwich, Conn.
G. F. Chace, of Taunton, Mass.
W. H. Childs, of Manchester, Conn.
Ezra Clark, of Hartford, Conn.
W. F. Codd, of Nantucket, Mass.
F. C. Coffin, of Boston, Mass.
R. C. P. Coggeshall, of New Bedford, Mass.
B. I. Cook, of Woonsocket, R. I.
F. H. Crandall, of Burlington, Vt.
Nath'l Dennet, of Somerville, Mass.
F. F. Forbes, of Brookline, Mass.
Murray Forbes, of Greensburg, Penn.
J. R. Freeman, of Boston, Mass.
F. L. Fuller, of Boston, Mass.
A. S. Glover, of Boston, Mass.
J. A. Gould, Jr., of Boston, Mass.
R. M. Gow, of Medford, Mass.
S. E. Grannis, of New Haven, Conn.
S. P. Griffin, of Lowell, Mass.
F. E. Hall, of Quincy, Mass.
Total, 63.

J. C. Hancock, of Springfield, Mass.
D. A. Harris, of New Britain, Conn.
L. M. Hastings, of Cambridge, Mass.
A. R. Hathaway, of Springfield, Mass.
W. M. Hawes, of Fall River, Mass.
A. G. Hayes, of Middleboro, Mass.
H. G. Holden, of Nashua, N. H.
H. U. Hyde, of Newtonville, Mass.
D. B. Kempton, of New Bedford, Mass.
J. A. Lockwood, of Yonkers, N. Y.
H. H. Lowe, of Clinton, Mass.
A. E. Martin, of S. Framingham, Mass.
T. H. McKenzie, of Southington, Ct.
A. F. Noyes, of West Newton, Mass.
J. F. Philbin, of Clinton, Mass.
E. H. Phipps, of New Haven, Conn.
W. D. Pollard, of Pottsville, Penn.
W. H. Richards, of New London, Ct.
J. W. Ringrose, of New Britain. Ct.
G. A. Stacy, of Marlboro, Mass.
F. C. Stearns, of Boston, Mass.
W. C. Swett, of Terryville, Conn.
L. A. Taylor, of Boston, Mass.
J. G. Tenney, of Leominster, Mass.
F. A. Volk, of Ware, Mass.
C. K. Walker, of Manchester, N. H.
F. W. Whitlock, of Waterbury, Ct.
J. C. Whitney, of West Newton, Mass.
H. F. Whittier, of Lawrence, Mass.
F. W. Wilder, of Woodstock, Vt.
H. B. Winship, of Norwich, Conn.
G. E. Winslow, of Waltham, Mass.

ASSOCIATE MEMBERS.

E. L. Abbott, representing Thomson Meter Co., New York City.

J. M. Betton, representing H. R. Worthington, Boston, Mass.

A. A. Blossom, representing Whittier Machine Co., Boston, Mass.

Randolph Brandt, representing Selden's Patent Packing New York City.

C. S. Brown, representing Hersey Manufacturing Co., Toledo, Ohio.

E. H. Dockam, representing Deane Steam Pump Co., Holyoke, Mass.

J. H. Eustis, representing Walworth Manufacturing Co., Boston, Mass.

G. B. Ferguson, representing H. R. Worthington, New York City.

Jesse Garrett, representing R. D. Wood & Co., Philadelphia, Pa.

H. P. Hutchinson, representing Standard Thermometer Co., Peabody, Mass.

J. C. Kelley, representing National Meter Co., New York City.

F. L. King, representing National Meter Co., New York City.

W. H. Lloyd, representing Smith & Anthony Stove Co., Boston, Mass.

J. C. K. Otis, representing Union Water Meter Co., Worcester, Mass.

G. S. Parsons, representing Holyoke Hydrant and Iron Works, Holyoke, Mass.

B. F. Polsey, representing Walworth Manufacturing Co., Boston, Mass.

W. J. Ranton, representing Porter Manufacturing Co., Syracuse, N. Y.

E. L. Ross, representing Chapman Valve Manufacturing Co., Indian Orchard, Mass.

George Ross, Troy, New York.

F. E. Stevens, representing Peet Valve Co., Boston, Mass.

L. W. Sumner, representing Sumner & Goodwin, Boston, Mass.

R. J. Thomas, representing National Meter Co., Lowell, Mass.

J. A. Tilden, representing Hersey, Manufacturing Co., Boston, Mass.

O. W. Weed, representing Randolph Brandt, New York City.

E. B. Williams, representing Fairbanks, Brown & Co., Boston, Mass.

H. D. Winton, representing Hersey Manufacturing Co., Boston, Mass.

Total 26.

HONORARY MEMBERS.

H. C. Meyer, of "The Engineering Record," New York City.

F. W. Shepperd, of "Fire and Water," New York City.

Total 2.

GUESTS.

E. P. Angur, Middletown, Conn.
J. P. Bacon, Boston, Mass.
M. N. Baker, "Engineering News," New York City.
E. S. Bartlett, Hartford, Conn.
Mrs. J. E. Beals, Middleboro, Mass.
C. H. Beaton, New Britain, Conn.
H. L. Bond, Boston, Mass.
Mrs. M. A. Brown, New York City.
C. H. Bunce, Hartford, Conn.
Ernest Cady, Hartford, Conn.
J. S. Chase, Hartford, Conn.
Mrs. E. H. Dockam, Holyoke, Mass.
H. F. Dunham, New York City.
B. K. Field, East Berlin, Conn.
A. A. Fox, Hartford, Conn.
G. W. Francis, Jr., Nantucket, Mass.
W. M. Gerring, New York City.
J. L. Gilbert, Boston, Mass.
D. W. Havens, Hartford, Conn.
J. H. Howland, New Bedford, Mass.
W. W. Jacobs, Hartford, Conn.
W. S. Jaynes, Auburn, N. Y.
Mrs. D. B. Kempton, New Bedford, Mass.
F. S. King, New York City.
H. G. Loomis, Hartford, Conn.
Mrs. F. H. McKenzie, Southington, Ct.
Miss Eunice McKenzie, Southington, Ct
Peter Milne, Brooklyn, N. Y.
G. Frank Monroe, Boston, Mass.
E C. Nichols, Reading, Mass.
Hon. Benjamin Page, Mayor of Meriden, Conn.
W. B. Palmer, Bridgeport, Conn.
R. Pattee, Holyoke Machine Co., Holyoke, Mass.
F. L. Pratt, Cambridge, Mass.
Mrs. E. L. Ross, Indian Orchard, Mass.
H. L. Schleiter, Meriden, Conn.
Mrs. J. G. Tenney, Leominster, Mass.
Mrs. L. A. Taylor, Worcester, Mass.
D. C. Toal, Water and Gas Review, New York City.
C. J. Underwood, Jr., "Engineering Record," Boston, Mass.
Charles Ward, New Haven, Conn.
I. M. Wheeler, Ansonia, Conn.

Total 42.
Total attendance, 133.

TOPICAL DISCUSSION

AT THE

CONVENTION, JUNE 10TH, 11TH AND 12TH, 1891.

MINIMUM SIZE OF MAINS ALLOWABLE.

THE PRESIDENT. We will take up the topic, "What is the Minimum Size of Mains Allowable for Water Supply?" We would be pleased if Mr. Brackett would give us a little information on this matter.

MR. BRACKETT. Mr. President and gentlemen, I have settled the question in my own mind, and I had supposed it was generally settled in the minds of all of our members, that it is not allowable to use for fire service anything smaller than 6-inch pipe. But still, while we may have settled that question ourselves, I suppose it is well we should emphasize it, for it is a fact that new works are built to-day where this is not carried out. My attention was drawn to this from a description in the *Fire and Water*, which has been distributed here, of new works built last year in New York, where over 50 per cent. of the mains are 4-inch pipe. While such things exist, it is our duty to emphasize the fact that mains should be made large, and I think it would be the experience of every one having connection with the management of works that no matter how large the pipes are made, it is but a few years before it is necessary to make them larger. The tendency is always to make them too small, and they surely should never be made less than six inches in diameter, where the supply is for fire purposes.

THE PRESIDENT. I would ask Mr. Brackett if he has ever placed in his study of the question, a limit even in the length of 6-inch pipe which would be allowable under the varying conditions.

MR. BRACKETT. Of course that would be dependent somewhat upon the class of property that was to be protected, whether the buildings are high or not, and it would depend also upon the class of hydrants which are used. I do not like to use a 6-inch pipe more than 600 feet in length where we are supplying four hydrant streams from the Lowry hydrants, which we use. Of course, in a suburban district you can use 6-inch pipe to 1000 feet in length; but I think there are very few cities where they ought to have them longer than that, and if they do they will run a risk.

MR. FREEMAN. I would like to endorse Mr. Brackett's statement that nothing smaller than 6-inch pipe should be laid for a hydrant main. When I had the pleasure of reading my paper on fire streams before this society, I think I advocated the doctrine that the intelligent man who laid a 4-inch pipe for a fire main should be hanged. I modified that statement somewhat in the printed record, but some members of the Association told me afterwards that they thought that that punishment was rather mild, if anything, in these enlightened days. (Laughter.) Our companies are purchasing experience continually as to the number of streams that a 4-inch pipe will throw, and it is

only six weeks, or eight weeks, possibly, since we paid some $300,000 for an object lesson to the effect that a long 6-inch main wouldn't furnish an indefinite number of hydrant streams. It seems to be seldom borne in mind that although a 4-inch pipe, perhaps 500 feet long, may, while it is new and perfectly free from tuberculation, in an experimental test with a short length of hose, give a couple of fair fire streams, that when you come to the actual conditions of a fire and run out even so short a line of hose as 300 feet, and particularly after the pipe has been deteriorating for several years in some classes of waters where tuberculation does occur, the capacity is nothing like what it is when new.

Then it seems to me, too, water works engineers, when they assume to figure out the deliveries of their pipe by any of the well known tables for capacity, to correspond to the given loss of pressure, sometimes lose sight of the fact that those tables are for new, smooth pipes, perfectly straight; and that when you consider the actual condition of a pipe that has been down a dozen years, you are dealing with entirely different circumstances.

I have not come here prepared to speak on this topic, but it may be of interest to give a brief statement in regard to the practice at Lowell. The pipes for supplying the water to factories there, are in the main under the control of the Locks & Canals Co., and were all laid out by Mr. Wm. B. Francis, who, as you all know, stands at the head of the hydraulic engineering profession in this country. Those were laid out many years ago, and although these factories are of enormous extent, and crowded together more than in almost any of our other manufacturing cities, and although some of the buildings are extremely high and shut in, so that all the conditions of a disastrous conflagration would appear favorable, the fact is that our losses in Lowell have been scarce half as large as they have in the country at large. Now, the main reason for that is to be found in the foresight of Mr. Francis, and in the very large water mains which he provided. I had occasion only a week ago to go through one of the large mill yards in Lowell, that of the Lowell Machine Shops, to see what might be needed in the way of additional fire apparatus or supply. It may interest you to know what I found as to the pipes going into that yard. There were two lines of 16-inch pipe which fed the hydrants in the yard; in addition to that there were four more lines of 8-inch pipe, and in addition to that two lines of 12-inch pipe, all connecting from the Locks and Canals reservoir, giving a pressure of 80 pounds. While, as a still further protection, on opposite sides of the yard, connected with opposite and independent *city* mains, were two 16-inch pipes with gates that might be opened in case the others failed. In some of the tests that they have made in some of the mill yards, they have drawn as high as 30 fire streams without reducing the pressure an unreasonable extent. That is perhaps an extreme case, but still the very favorable experience we have had in fire losses being kept so low, seems to justify the policy of having these large mains.

THE PRESIDENT. It seems to me that in the consideration of this question of the minimum size of pipe allowable, the length of the main is too often lost sight of, and that it really is an important factor. I know some works, where they have long lines of 6-inch pipe, and because they have 6-inch pipe

they think they are amply provided for; but I believe the time will come when those pipes will be found to be insufficient. I think also the pressure is an important element to be considered.

MR. FULLER. I would emphasize what the President has said, that the pressure is a very important factor in determining upon the length of 6-inch pipe which would be allowable; because under a pressure of 110 or 115 pounds a line of 6-inch pipe could be used where it could not be used if the pressure was only 40 or 50 pounds.

MR. WHITNEY. At the meeting in Portland, Mr. Brackett alluded to the large amount of small-sized mains laid in the city of Baltimore. I had the curiosity to look that up and see how it compared with some other places, and I found that they have some 60 per cent. of main pipe less than six inches in size; while the city of Boston has only something like 6 per cent. Now, it seems that the fire losses in the city of Baltimore compare quite favorably with the fire losses in the city of Boston, and it would seem to show that a fire supply could be obtained from smaller mains than we talk about.

MR. BRACKETT. There is one thing we should consider in connection with the Baltimore supply, and that is although they have a large amount of 4-inch pipe, the greater part of that was laid during the original construction of the works, and they have duplicated it in the business part of the city by laying additional mains, leaving the old ones in the street, so they have a better protection than would be assumed from a simple study of the size of the pipes; although they do now ay a large amount of small pipe, more than I should deem proper.

MR. WHITNEY. With regard to that, of course I do not know through how many streets they may have duplicate lines, but during the year 1890, 58 per cent. of their pipe laid was 4-inch pipe.

MR. TAYLOR. I will say this with regard to Baltimore, that the conditions, I think, there are quite peculiar. The water does not corrode cast-iron pipe. I have seen pipe laid more than 40 years perfectly clean, and that means a very decidedly different state of affairs than is found in most places. With no coating, the water does not corrode the pipe at all.

THE PRESIDENT. Is the pipe they use, common cast-iron pipe, coated or uncoated?

MR. TAYLOR. Uncoated. They never coat their pipe; the character of the water is such they do not require it.

MR. COFFIN. It will make a great deal of difference in a system of piping, how the streets are laid out. If you have long lines of streets and not many connections across, and then you have a large percentage of small pipe, you have a very inefficient system; but if you have streets laid out in squares, with your large mains running one way, and small cross connections merely, you could have a very efficient system; and still use a considerable percentage of small pipe. I don't mean by that to defend small pipe, but it might be an explanation of the case of Baltimore, though I don't know how the streets there are laid out.

THE PRESIDENT. That is where the elements of length and pressure come into the problem. I would ask Mr. Whitney if in coming to his conclusion

he knows certainly that the loss by fire in Baltimore and in Boston have differed to any great extent over any considerable length of time.

MR. WHITNEY. I have no figures whatever, but never having noticed any very extensive fires reported in Baltimore I took it for granted that their loss must have been less than in Boston.

THE ADVISABILITY OF THE USE OF WATER METERS.

The President called on Mr. Whitney to discuss the topic, "To What Extent is the Use of Water Meters Advisable?"

MR. WHITNEY. Mr. President, I do not know that I have made any special study of this question. Of course I am a meter man, and I believe in meters, and believe in carrying out the meter system to as great an extent as possible. Where we draw the line in Newton is on kitchen faucets; everything else there has to be covered. If the system were extended to cover kitchen faucets in houses it would certainly be necessary to establish two minimum charges, and possibly more than that, making your minimum price on the kitchen faucet either $4 or $5, and charging $1.50 or $2 rent for the meter. Whether it is advisable to carry the metering as far as that is a question, but I think there is no question but what eventually it will be carried to that extent. Whether the time has now arrived, I think is a question.

MR. CHACE. I have some figures here which may be interesting. Last year the total number of gallons which were pumped in Taunton from the pumping engine records was 290,801,368. Now, of that number of gallons there passed through 901 domestic meters 37,276,077 gallons; manufacturing, 82,843,316; a total through meters of 120,119,793. So that it would leave for gallons pumped not metered, 170,681,575. The amount pumped for fires, as computed from the engine records, estimating for fires what was pumped over and above what had been pumped for an hour or two before the fire, was 400,407 gallons. There were 17 leaks in the mains during the year, and as some of those were very small, nothing more than a leak from the stuffing box, where the gate had been opened the day before, or something of that sort, 50,000 gallons would be a very liberal allowance for each, and that would make 850,000 for the 17 leaks. Subtract that from the 170,000,000, and that leaves as the amount passed through 2263 services not metered, 169,431,168. That would be an average for each service of 74,870 gallons. Now, the 37,276,077 passed through the domestic meters, divided by 901, the number of meters, would make the average 41,371 gallons for each domestic metered service. The receipts for 901 domestic meters were $11,089.27, or $12.31 each; for 2263 unmetered services, $21,214.75, an average of $9.37. For metered water we received 29.7 cents per 1000 gallons, and for unmetered 12½ cents per 1000 gallons. The cost of pumping 1000 gallons, based on the total maintenance expenses, including interest, on the cost of the works, was 13 cents and 8 mills per 1000. That would leave a balance of 5 cents and 9 mills per 1000 gallons for the maintenance expense, and 1 cent and 3 mills as the loss on each 1000 gallons for unmetered services. So that the gain on 901 domestic meters was $2199.29, and the loss on 2263 unmetered services $2202.61; a balance of loss of $3.32.

That is, practically, the net income on 901 metered services balanced the net loss on 2263 unmetered services.

SHOULD METERS BE OWNED BY THE WATER TAKERS.

THE PRESIDENT. We will take up the topic, "Should the meters used be owned by the water takers?" and we will be pleased to hear from Mr. Whitney, Water Registrar of Newton, who I think has given a great deal of study to this question.

MR. WHITNEY. Mr. President, I cannot say I have given any great thought or attention to this subject, but I am certainly of the opinion that it is very much to the advantage of both the water taker and the city to have the meters owned by the city and rented to the consumer at a percentage, say, of 10 per cent. on the cost, that is a fair figure, or, as some do in Newton, $2 per year for the ordinary house meter. This probably pays the city a small profit, but it was thought to be just as well to set the figure, perhaps, a trifle high, and come down on it some time hereafter, as to make the figure perhaps a trifle too low and have to raise. We have now about 2,000 meters that have been set under this system, and from the start up to this date they have given perfect satisfaction both to the city and to the water takers. We have also about 1,000 meters which are owned by the consumers, who pay for the expense of the repairs on the same. We find that this makes considerable trouble and friction between the water taker and the department, because the water taker usually has an idea that his meter is all right, and when the city insists that it is out of order and takes it out and renders a bill for repairs on it, he has an idea that money is being extorted from him in some way, and that it is a scheme to get larger water rates from him. Of course where the meter is owned by the city we take it out when we deem it necessary, and make the repairs, and return it without any expense whatever to the taker. It saves a great deal of trouble, and we consider it is mutually advantageous.

MR. WHITLOCK. In the case of Waterbury the method of paying for metered water is very similar to the plan adopted in Newton, with this exception, that we make no charge for meter rent unless the rate is below the minimum rate for family use. Our charges are for use by fixtures and also by meter, and we allow no meter bill to fall below the minimum rate for the family use; if so, a charge of 10 per cent. is added for the meter, and that is the only case in which we add it. I can see no advantage to either party to be gained from the user owning his meter. I can conceive of no case in which it could be to the advantage of either party.

SERVICE PIPES.

MR. RICHARDS. I think the ground has been pretty thoroughly ploughed over before. I am strongly in favor of lead for service pipes. We have tried plain iron, rubber coated, and cement lined, and we finally have concluded lead is not only the best, but the most economical in the long run. I think with our water ordinary black iron will last about two years before the pipe will fill up. The coated will last some time longer, and galvanized will last

about 10 or 12 years. I do not know how long lead will last; I hope it will last forever. But it is no economy at all to use galvanized iron lasting 12 years, for when you have to relay it you will have spent more money than you would have in putting in the lead pipe originally. I do not think there is any danger to be apprehended from lead poisoning, except possibly with water of an exceptional character.

MR. PHILBIN. How long will the cement lined last?

MR. RICHARDS. The cement lined, as we finally laid it, with tin-lined couplings, stood very well, but it is rather an awkward pipe to lay, and certainly no better than lead.

MR. WINSLOW. Cheaper?

MR. RICHARDS. A very little cheaper.

MR. BEALS.* This question of service pipe was pretty well considered last evening. I am asked very frequently which is the best pipe for service pipe, and I always reply frankly, "I don't know;" and after listening to the discussion last evening that was about all the information I got. When we commenced our work six years ago, we adopted as our standard service pipe a cement-lined pipe, a one-inch pipe lined with cement to three-quarters of an inch, not because we knew about it, but because the water systems around us had used it with some success. The nature of our water is such that it acts upon iron quite actively, and I have found even inside of our cement-lined pipe tubercles of rust partly filling it up. It does not seem as though it could have got to the iron through the cement, and where the rust came from I don't know, but there it is. For inside work we have tried the rustless iron and we have tried the plain black iron. Plain black iron will rust very quickly, and the rustless iron is not much worse than plain iron to rust. (Laughter.) It is a poorer pipe to lay; it is tender, and it will rust through in pit holes instead of the other form of rust, and very soon give out. We have tried enameled pipe. I recollect we had one quite long service of enameled pipe, one inch and a half, and very soon, within a year or two, the pipe was filled up and we had to take it up, the enamel had flaked off and pushed along so it formed a complete obstruction. So we have come to the conclusion that enameled pipe is much worse than plain black iron. Again, when we first began, we put in a good many services of tarred pipe. Well, as soon as the tar taste is gone we found it began to rust, and rusted just as fast as the plain black pipe, so we saw no advantage in tarred pipe. We have very few lead services, but I have a piece of lead at home, taken from the inside work of a house, and when it was handed to me it was coated on the inside with a white coating—I don't know that white lead will dissolve in water—but when the pipe was taken out the inside was coated with a thin coat, which, when dry, looked like powdered white lead. If that is the case and water in going through the pipe—is carrying poison, oxide of lead,—I don't want to sell that to our customers. So, after going the whole round of all the pipes, we have come to the conclusion we cannot do any better yet than to be satisfied with cement-lined pipe. I know the lead pipe people laugh at us for being a little fearful of lead poison, but I don't care if they do; so long as there is one customer in ten in the town who fears lead pipe poison, I don't want to alarm them by furnishing them with

*See Mr. Holden's paper on Lead Connections.

lead services. I am sure I had rather drink a solution of iron than drink a solution of lead. I have simply given the experience of a few years with a small plant, but there are men here who have the care of a great many more services than I have, and perhaps they can give you some more reliable information.

I would like to say just a few words more. Last year we found that even the lead pipe, which was taken up, was pitted through and leaking. We have all sorts of soil, from rocky soil through which the trench has to be blasted, to very fine quicksand. We find that iron services put through that quicksand, where the water settles off very rapidly, are as good after five years as when they were put in. We find in some of our clay soils, where the pipes are alternately exposed to moisture and coldness, and then to heat and dryness, that the pipes rust from the outside.

MR. COGGESHALL. I would say that in New Bedford we have got not far from 6500 services now of lead. When we started there we gave the takers their choice between lead and cement lined; but about the year 1874 we had so much trouble with the cement lined pipe, it was decided to abandon that altogether, and from that day to this nothing but lead has been used there. I have had a great many of the early lead services dug up, in one instance, I remember, the first service which was laid in the city, just for the purpose of inspection, and a piece cut out, and I can show specimens from a number of places, and I have yet to see a piece of pipe which showed the least sign of disintegration inside. There forms in a very few weeks' time, I think in two or three weeks, a slight coating over the fresh surface of the lead, and if you take that out and allow it to dry for a day or two you can take it out carefully with your knife, and the lead is as fresh as the day it went in. I know of one instance where I took out a service which had been in use for a number of years, where there was a change in the building, and the pipe was in such good condition we used it for another service. The only case where the lead pipe has given us any trouble is in one or two places where a poor coil of pipe, as was suggested last night, pipe made of scrap lead, happened to be used; and the trouble with that was from the outside, not from the inside.

MR. CHACE. We use in Taunton the cement lined pipe with the lead goose neck connection. Some little time ago one of our Commissioners, being a physician, had a case of lead poisoning, and feeling a little anxious to find out the cause of it he asked me quietly to investigate the matter with reference to the service. I found that beside the lead connection there was in that particular house a piece of lead in the service, which had been put in with the idea of trying to stop the vibration from a noisy meter. It didn't amount to anything for that purpose, however. I took out that lead and examined it, opened it and found this coating of sulphate of lead, showing that there wasn't any action going on at all injurious so far as that was concerned. Then I had the lead connection taken up and took that out and found that that was all right. Then I investigated still further, and found that this man had been in the habit of riding a hobby in the form of drinking a cup of hot water every morning, and that this water was heated in a copper kettle lined with tin, and everybody knows that this tin lining contains some lead. I asked if

I could have that kettle, and I took the kettle and kept hot water standing in it for several days, until I thought it had a good chance to get the effect of whatever was there—by the way most of the lining was gone so I had to fill the kettle, so I didn't have much of a show—after keeping the water standing in it all that time I made a test and got a slight trace of lead in the water; and I concluded that if the kettle had been as it was originally, with all the lining, perhaps there would have been some more lead, and perhaps he had got the whole of it in his system, and that his trouble was more likely due to that than to the lead pipe. Yet I am afraid to use lead pipe.

MR. BEALS. I ought, perhaps, to say that the piece of lead pipe which was coated, to which I referred, was not taken from a service but from some inside work, that had been connected with the hot water portion of the inside work, and that may be the cause of the white deposit. I will say still further that I have never discovered any evidence of the action of the water upon the goose necks which we use in putting in our services, neither a white deposit nor any indication of the lead being worn off, and the pipe is the same color as when it was put in. So I cannot say I really believe that our water, in its natural form, before being heated in a lead pipe, is taking up and carrying forward lead, but I am still afraid, as Mr. Chace is, of lead poison. It may be that I will get over that fear in years to come. We have some lead services, and I have never discovered in any examination I have made any indication of lead poisoning; but lead poison is an accumulative poison, it works slowly, and we may wonder after it does come where it came from and why it didn't show itself before.

MR. COGGESHALL. I will say that we have had a little experience with tin-lined pipe, and that is the meanest pipe of the lot because that will eat away and destroy itself. I think that the eminent authority, Prof. Nichols, went into this subject very carefully some years ago, and he very strongly favored lead pipe. I know it is used now in all of the large cities, and we have not heard of a case of lead poisoning from the street service connection. It is another thing when you talk about its use in the house.

THE PRESIDENT. I will ask Mr. Coggeshall if he has ever had that coating he speaks of being able to take off from the pipe, analyzed, to know what it is composed of?

MR. COGGESHALL. I never did, but some of you know that we have rather peculiar water in New Bedford, quite yellow in color, and containing considerable peaty deposit, and I think it is probably a thin coating of that deposit which accumulates on the inside of the pipe.

THE PRESIDENT. That is what I wished to know, whether it was organic or inorganic?

MR. COGGESHALL. I think it is organic.

MR. WINSLOW. It is this deposit on the lead pipe which has always made me think that lead pipe was the proper thing to use. When water goes through a pipe and leaves it bright and clean as it was when it was put in, it looks to me as if it was eating the pipe and putting it into solution, so the consumers were drinking it; whereas if there is a deposit on the pipe it keeps the water from coming in contact with the pipe and consequently you are not

getting the solution. I know in our lead connections we find a coating on all lead pipe which has been in for any length of time, and I also know that the water that we use is not suitable for boilers. It will deposit a good deal of scale, and I have had an idea that the deposit on the inside of the pipe, instead of being lead, is a deposit of scale from the water itself, and that that would protect the lead from the water. If I should see the lead bright and clean I should surely be afraid of it.

MR. RICHARDS. I think I agree with Mr. Winslow perfectly. If the pipe was clean I should be afraid of it. We most always find it coated, and it is the coating that protects the pipe. I never saw one which was bright and clean, after it had been in use a short time.

MR. BEALS. I would like to ask if when he takes these lead connections out the coating he sees on it is hard or soft when it is moist?

MR. WINSLOW. It is hard.

MR. COGGESHALL. It is hard when we find it in our pipes.

MR. PHILBIN. I would like to ask the Secretary and any others who have cement lined pipe, how long it has been in use when they have had to take it out.

MR. COGGESHALL. Our pipe has generally given out right at the sidewalk cock. We don't use cement lined pipe; we think it may be very good pipe, but we think lead pipe is a good deal the best.

MR. PHILBIN. How long was it in use?

MR. COGGESHALL. Oh, perhaps six or seven years.

THE PRESIDENT. In what way does it give out?

MR. COGGESHALL. It gives out at the sidewalk, generally, by pulling apart. Generally a leak appears in the service cock; we have had quite a number of such cases.

THE PRESIDENT. How do you account for it? Does the water get to the iron and eat away the joint?

MR. COGGESHALL. Yes.

MR. FULLER. In Franklin, New Hampshire, where we are putting in works, there are a great many small lead pipes coming down from the hills, which have supplied the people there with water for a great many years. I presume in some cases for thirty or forty years. I do not imagine these pipes were very heavy to begin with, and, certainly, if there had been much solution of the lead by the water passing through it they would have disappeared long ago; but they seem to be in just as good condition as they ever were. And I have noticed that they have this coating on the inside, which is apparently hard, and can be scraped off. I should judge that if a foot of the pipe was weighed now the difference between the weight now and what it was when the pipe was put in would be very slight.

With regard to service pipe, I have always thought lead was the best, and that next to that was the cement lined wrought iron pipe. We have used it in Wellesley for five or six years and have never had any trouble with it. If it is carefully handled, and some provision is made for lining the coupling, perhaps there is no better service pipe. Somebody has spoken about it being easier to dig a trench for lead pipe; that might be true where there are a great

many boulders, but in such a soil as we have in Wellesley we have no particular trouble on that account, because we have very good digging, and it is perfectly easy to dig a straight trench. I suppose that lead pipe is becoming more popular as a service pipe than it was formerly, and I have no doubt it is more economical than anything else, because it will last almost indefinitely.

MR. TENNEY. I would like to say a word in favor of cement lined pipe. We have never used any other, and in the nine years we have had it in use I have never known a case of its giving out.

SHOULD FIRE SERVICES BE METERED?

THE PRESIDENT. I am pleased to call upon Mr. John F. Freeman, Hydraulic Engineer to the Associated Factory Insurance Companies, for a few remarks upon this topic.

MR. FREEMAN. Mr. President and gentlemen, I have not had the time to prepare anything in the nature of a paper, and in fact, I hardly think a written paper is necessary, for my opinions can be stated very briefly and directly. I had hoped some one else might speak upon the subject first. The question is, "Is it desirable that the whole supply to a large factory should be metered, or should the fire service be separated from the domestic service?" My experience leads me to reply most emphatically that meters on a fire service should be avoided, and that, if meters are to be put in, the fire service to a large factory *should be* separated from its domestic service and the latter alone metered. I will cite one or two actual cases which are, I think, good, fair, practical reasons why the fire service *should not* be metered.

The first is as follows: When one of our inspectors sometime since was testing the appliances for putting out fire, at a very large factroy in one of the cities near Boston where things are very well managed, the hydrant streams suddenly ceased, the factory mechanics investigated the matter for a length of time which might have been fatal had there been an actual fire instead of merely an experimental test, and they finally concluded the trouble was with the meter. The water works mechanic then was sent for and found a stone had lodged in the water meter and prevented the meter from turning and thus prevented the delivery of the fire streams. That illustrates one of the dangers of having meters on a pipe which is relied on for fire service.

Right in that same city, I recall another instance of a somewhat different trouble. A very large meter had been placed upon a fire service, and it so happened that almost no water was drawn from this pipe for any other purpose. The meter stood there without having occasion to turn around, and it stood there so long that it got fixed in one position, and when one of our inspectors went there to make a trial of the water the water would not flow with any force. That led to considerable delay, and after a delay which, as in the other case, would have been fatal in case of an actual fire, they discovered the trouble was in the meter, and that it had by long idleness become so obstructed by sediment or corrosion that it would not turn around. Defects of that sort are always *liable to occur* with meters of the types most commonly used.

The amount of water drawn for fire purposes is so very largely in excess of any domestic draught that if there are any stones, or any obstruction of any kind, fish, eels in the pipe, or anything inside of the pipes, which has escaped the screens or been left by careless pipe layers, anywhere within the vicinity of the point where this draught occurs, it is almost certain to get rushed along toward the outlet and be forced into the meter if one is there. In my own experience I have seen dozens of cases where the fire nozzle has been suddenly choked by a stone brought up through the pipes, and probably every man here has seen cases of that kind. When a nozzle gets choked anyone knows what is the matter, and a few seconds will serve to fix it. If the meter gets choked it may take a long time to find what is the matter and still longer to fix it. Whenever you put a meter on a fire service you endanger or impair the efficiency of that service.

At factories we occasionally find large meters which have been put into the fire pipes without their being any by-pass around them. The water must come through that meter, or can't come at all.

In other cases, they will tell us that the contingency of obstruction in the meter is amply provided for by having the meter located in a by-pass, and having a gate in the main pipe which will be ordinarily kept closed, but which will be opened instantly on an alarm of fire. Theoretically, that may appear a very nice remedy for this difficulty, but how does it work in actual practice? I will take the case of the Pemberton Mills in Lawrence. They had an 8-inch pipe in their yard with an 8-inch meter on the pipe; the meter was admirably located in a safe and accessible place just outside the yard, and every man connected with the yard service was supposed to know all about the meter and the by-pass around it and the boss of the yard had orders, should there be an alarm of fire, to go instantly and open this by-pass.

Well, they had a fire four or five years ago and it burned until it cost the companies which I serve about $80,000, and the firemen wondered why the city water wasn't giving a better pressure. The mill firemen all confined their attention to the "business end" of the hose, as one afterwards expressed it. No one thought to go back to look at that meter until the superintendent of the water works, who had got down into that part of the city, bethought himself of the meter, went into the cellar, and found it "just a-humming." He opened the by-pass and after this they had a little better pressure.

In that same city I well recall the case of another one of the large factories, which was also provided in the most admirable way, with a by-pass to be opened in case of fire, and with the men thoroughly drilled, as it was supposed, to open it immediately on an alarm; but the same thing happened as at the case just mentioned. The by-pass was forgotten and the meter operated all through the fire, and when the mill men went to it afterwards they found it had rolled up a bill which ought to satisfy a meter for its lifetime.

In our general experience we find that no matter if you do provide these by-passes, the men in the excitement of the fire don't go to the back end of the line to look for trouble; although a by-pass is better than no by-pass, it is by no means a satisfactory remedy.

Another remedy proposed is to put on a meter larger than the pipe. Now

if a factory puts in one of these extremely large meters, the loss of pressure is remedied or materially lessened so long as the meter does not get clogged. If a meter of what has been called the "inferential" type is put in, we might be satisfied from an insurance point of view, but will you, water works superintendents, be satisfied? A single 1 1-8 fire stream under a fire pressure draws about as much water as would be necessary to supply, for ordinary domestic purposes, a population of five thousand people. So it is, that if you attempt to put on a meter large enough to pass half a dozen of these fire streams, you are getting a machine which is not accurate enough—will not work down fine enough—to serve for measuring any ordinary draught of water. It is like weighing tea on the hay scales. And water enough to pay for the meter can gently slip through without registering a single mark on the smallest dial.

Now, as to the employment of any meter. There are some meters, as we all well know, so constructed that if a very small obstruction gets into the machine it stops it so as to almost cut off the whole water supply. There are other meters in which the piston will roll over a considerable obstruction. There are other meters, which will let a large flow pass, though the piston be blocked to stand still, and which are sold as specially adapted to fire services, and I believe that some one will yet devise a meter of this latter type, in which the resistance or obstruction will be unobjectionable. I have experimented somewhat with one of the inferential meters now in the market, and I was in the first place interested to see the resistance or loss of pressure which it caused. You find it stated in the trade circulars of that particular meter, (I happened to notice this statement in one in the ante:room a few moments ago), that a 4-inch meter will pass something like 960 gallons of water per minute under a pressure of 60 pounds. Now, I never understood exactly what that meant, "under a pressure of 60 pounds," and I have found there was a misapprehension on the part of water works people as to what that meant. If it means it will pass 960 gallons a minute under a pressure of 60 pounds at the inlet of the meter with an open butt, with no back pressure at the outlet of the meter, that is one thing; if it means that it will pass 1000 gallons with a pressure of 60 pounds at the upstream side of the meter, and with anything that can serve as a fair fire pressure at the other side of the meter, that is an entirely different thing. I got one of those meters and set it up and connected two very accurate pressure gauges, one just upstream and the other just down stream, from the meter, and although it was not so bad an obstruction as I had expected it would prove, it nevertheless was a serious obstruction. When that meter was passing 883 gallons per minute, there was a loss of pressure within the machine itself of 16.6 pounds, or 38.3 feet head, which is quite a good deal to take away from the effectiveness of a fire stream. If it had been called on to pass the amount that the circular states it would pass, 1000 gallons per minute, it would cut off 21 pounds from the pressure, or about 50 feet from the head on the stream. I next fastened the fan or propellor of the meter so it could not revolve, and tested it again and found that it would pass 716 gallons a minute, or two extra good fire streams, or three fair 1 1-8 inch streams, with a loss of only 30 feet head.

I do not see how any meter of either of the types now commonly used on a pipe which is to serve for fire protection can be regarded as anything but an obstruction and a source of danger, but as already intimated I hope to see a safe one, and one in which the obstruction will be very small, invented.

In my missionary labors in several of our cities in the effort to get the Water Board to allow the fire supplies for certain to be drawn without the interposition of the meter, I am pleased to say that I have generally found that the trouble did not come from a lack of understanding of the danger by the superintendent of the water works, but often comes from false economy on the part of the people who pay the bills for putting in the pipes, and who sometimes are disposed to dodge putting in the two separate services.

To-day, I think that in nearly all of our leading cities the custom of a separate and unobstructed pipe for fire is growing in favor. At Fall River, at nearly all of the mills, the main fire pipe is entirely independent from the other pipe. A 6-inch or an 8-inch pipe will be carried into the yard for fire purposes, and a 2-inch pipe for their domestic supply, and a meter placed on the 2-inch pipe, and I think that, save in possibly a single instance, they have not found any trouble to arise from this practice. The objection is heard in some places that with no meter on the fire pipes water may be taken surreptitiously.

From my experience, I believe that the men who manage these large corporations are in 99 cases out of 100, men who can be trusted, men who would not stoop to so small a thing as the stealing of a little water. Occasionally there may be men who would connect on to the water works main without saying anything about it, but such cases are so rare that we are justified in taking this small chance of loss of revenue rather than to subject a large mill, the chief source of prosperity to the town, it may be, to the serious danger of putting a meter on its fire main. If the yard pipe system is laid out properly in the first place, if in the beginning there is a design to have two independent systems of supply in the yard, these pipes can readily be arranged so that the chance of a man attempting to steal water will be very small indeed. It is simply a question of keeping your fire system down to the very lowest terms as regards simplicity, avoiding all complexity of branches, and have a *simple* Fire-pipe system *which can be readily inspected*, and which has no connection to the tanks or pumps for manufacturing purposes, or to the engine condenser, and no gates whatever through which a man might be tempted to draw off water, or which an "unauthorized laborer" can "accidentally" leave open. If a man, in order to obtain water surreptitiously has got to boldly and conspicuously take it through a hose nozzle, or if he has got to go and break into the pipe and connect on, he isn't very apt to do it. If, on the other hand, there is a complicated pipe system, and if it is merely necessary for some irresponsible workman to open a gate, this may cause temptation.

It is well to paint all fire pipes within the mill red, to facilitate following them, in making sure by inspection from time to time that no unauthorized connection to them has been made.

I will state but one more reason for this advisability of divorcing the domestic service from the fire service; this reason is, the lessened corrosion of

the fire pipes. We find sometimes a strong temptation to tap the automatic sprinkler pipes to get water for a sink tap. We have had to oppose this practice most vigorously. Our experience goes to show that where an automatic sprinkler system, with its great length of wrought iron pipe, is filled with water, and then the water is not changed by having a gate at the outlet of the pipe, so the water, after it is once in there, stays there till there is a fire, the corrosive properties contained in the water are soon exhausted; and I have taken down pipe after pipe, at mill after mill, even in places where the water has considerable corrosive property, and have found the scale on the inside of the sprinkler pipes, where the water had not been changed, would hardly exceed the thickness of a sheet of writing paper. But if, on the other hand, the water is changed in these sprinkler pipes you will, with each change, bring in a fresh supply of oxygen, and a fresh supply of vegetable acids, and corrosion will go on almost as rapidly as it does in the ordinary house service. So here is a reason why we should guard against any unnecessary circulation of the water in any fire circuit which is composed in part of wrought iron pipes.

THE PRESIDENT. I would ask Mr. Freeman how long he has known the water to have remained in pipes he has examined.

MR. FREEMAN. I remember a number of cases where it had been there from three to six years, but I find it very difficult to find mills where the water has stood so long as that. I will say that the water, when it is drawn out from these pipes after standing so long, is usually as black as ink, and the master mechanics at the mills are apt to have an idea that the water is very foul and ought to be changed. It is hard to get them into the way of thinking that the water has had its corrosive property exhausted, and that it is much better to keep it there than it is to flush the pipes out and fill them with fresh water. The water has a foul appearance, but it has had its corrosive properties exhausted.

THE PRESIDENT. Do you find in any case a deposit sufficient to obstruct the sprinklers at all?

MR. FREEMAN. We do, sometimes, but here in New England we have but little difficulty in that respect. As you go further south or west and get into a region where the waters carry more sediment than they do in our New England streams, there may be trouble especially if as among many of the Pennsylvania factories, the sprinklers are supplied from a tank in the top of a tower, with an overflow from this tank which supplies the privies, so arranged under the idea that if the privies have a supply of water, then of a certainty the tank for fire purposes must be full.

Now, with that arrangement you are really making a settling basin of your fire tank, and we suffered one severe loss from a case like that. As the facts were stated to me, this was at a place where the force of the city water was not sufficient to supply the sprinklers in the upper part of the mill, so this auxiliary tank was provided. The tank served as a settling basin for the impurities in the water and, of course, after a series of years a considerable amount of sediment became deposited in the bottom of the tank; that sediment worked its way into the sprinkler pipes which led out from the bottom

of the tank, and the result was that the sprinkler pipes were nearly filled with mud. For this reason it is well to keep your tanks solely for fire purposes.

THE PRESIDENT. What I meant to ask was whether there was a sufficient accumulation in the pipe itself, where it was received direct. You say the water when first drawn is black and foul, and that there is a very thin coating of rust; in any case do you find that there is accumulation enough there to interfere with the operation of the sprinklers?

MR. FREEMAN. In a great many cases I have found the sprinkler heads completely filled with a very soft black mud, and I have tested a great many of those heads with special care to see whether that would interfere with the operation of the sprinkler. So far, except in one case, I have found that the sediment—which is sort of a paste-like substance—would readily yield and flow out the moment the sprinkler was opened. I think that if the water is not drawn off from the pipes, so that the sediment has no opportunity to cake on and become hard, that generally it will not prove an element of serious danger.

THE PRESIDENT. I think our Secretary, Mr. Coggeshall, has had some experience with this subject at New Bedford.

MR. COGGESHALL. I do not know that I have had a great deal of experience in this matter, but we have, perhaps, some of the largest mill supplies there are in New England in New Bedford, and perhaps some of the most difficult problems to solve that they have to solve in any place in New England. In some of our mills there has been no attempt to meter anything but the direct supply which, in my opinion, is the part that should be metered; but in other mills the system has been laid out in such a way that it was impossible to meter the mill, unless a meter was put on the whole supply. I know one large concern there that dates back, I think, as far as 1849, which has grown from a small mill to a very large mill today, and I do not believe the man is living who knows half the pipes that are on the premises. I know two years ago Mr. Freeman was down there and laid out a very elaborate plan, including a salt water well, with a supply leading from the river into this well by gravity, the water to be taken from this well by the pump around to the different hydrants. I have carried out part of the work, as the finances of the mills have permitted, with a view of completing it sometime in the near future. Well, when we came to get the pump into connection and tried to get the pipes into position, it was nothing but a set of specials. I hardly believe there was a foot of straight pipe that went into the work. They unearthed pipes there, but what they were and where they went to they hadn't the least idea; they found gates there, but what they were for they hadn't the slightest idea. To undertake to separate the supply for that mill into two systems would almost involve starting from the very beginning and doing the work all over again.

Our water rates are very low in New Bedford; only 2½ cents a thousand gallons for manufacturing purposes. Unfortunately a lady left $100,000 to the city of New Bedford for the introduction of pure water for manufacturing purposes, and the city government at that time, in 1870, in return for this bountiful bequest, decided to make the charge for water practically nothing,

that is, to give it to the manufacturers. As a consequence of that, it is cheaper oftentimes for the mill people to open the gates and pour the water, even though it may come through a meter, into their condensers, rather than to pump the salt water which is right at their door. And that is an element we have to contend with, because oftentimes the pipe that supplies the condenser comes out of the pipe that supplies the sprinklers, that is, all the water is running through that pipe. In fact, I have been there in a mill yard within a year, a mill in which the supply is separated, and found two lines of hose from a hydrant back of the engine house running right into the well, and there they were pumping it up for condensing purposes. That is the trouble we have to contend with in New Bedford, and it has been quite a serious matter. Just how this thing is going to come out in the future I don't know, but it seems to me if we could get our rates put up to where the water had a value, perhaps we might be going a long ways towards remedying the trouble. I would say that I entirely agree with Mr. Freeman, as far as separating the two systems is concerned. I remember going by another factory in New Bedford, several times, and seeing the hose out and people waiting around the mill. After seeing this once or twice I went in to make inquiries about it. They said, "That is all right; the inspector from the insurance company requires us to try this hose once a week, so it is all right." (Laughter.) I noticed that they used to try that hose very frequently in warm weather. (Laughter.)

MR. COOK. I am very glad Mr. Freeman put so much confidence in manufacturers, but my experience with them is that they will bear watching.

MR. FREEMAN. I forgot part of my story when I was on my feet. Perhaps I might suggest that where there is a separate system put in it should be put in with the understanding, as I have had in several cases, first, that the pipe system shall be laid out so that it can be readily got at and inspected; second, that the water works inspector shall be furnished with a pass which will give him admission to the mill yard at any time; and, third, that all the openings shall be sealed with an arrangement similar to a car seal. Now, it is very easy to seal your hydrant so that if it is opened it can only be opened by the breaking of this seal. All that is required is a piece of copper or iron wire and a lead seal, such as is used on a freight car, or in the Custom House, or by express companies. These seals perfectly protect carloads worth thousands of dollars, and I do not see why, notwithstanding the fact that one may say they can be tampered with, why they will not be adequate to protect a hydrant against being opened in an unauthorized manner. Then as to your valves, there need be but few valves, except your blow-off valves, which would have to be watched. These blow-off valves can readily be sealed in the same manner. Then, as to your sprinklers, no water can be drawn from these except in case of fire, so really even if a man does need watching, the problem of watching him and watching him in a very safe way, is quite a simple one.

MR. COGGESHALL. It is, if you can see all the pipe, there is no trouble about it then. But the trouble with us has been that oftentimes the pipes have been tapped where they cannot be seen.

HOUSE INSPECTION OF FIXTURES.

The President called on Mr. Hathaway, the Water Registrar of Springfield, to open the discussion upon the subject.

Mr. Hathaway. I always supposed that children were expected to keep quiet and listen. As this is my first appearance as an active member of this Association, I am but a child among you, and was in hopes I might be permitted to remain quiet to-night; but your president, I believe, wrote to our superintendent a short time ago asking for a few suggestions from him on this topic, and he referred the matter to me, and asked me to bring down a few sample pages from our inspection book showing the manner of recording the facts found. For convenience in inspection our city is divided at the present time into twenty-nine districts or sections, and we have for each of these sections a book about 11" x 6½" in size, containing 100 leaves and of the form as shown in sample page. Besides using these books for inspection, they are also the *only rate books* we have and the ones from which our billing books are kept corrected.

In first writing up and arranging the matter in a new book, plenty of spare lines are left for interlining additions or changes found.

In a business section, to record one block, may take seven or eight pages in a book, while another block takes a page, or half a page; but in the resident sections, for domestic use, there may be four or five premises recorded on a page.

Each book, in turn, is taken by the inspector who, every morning, places the date at the top of the first page inspected, and the number of pages between these date entries show at any time the exact amount and nature of the work done and territory covered.

He also makes a daily report, on a blank form (copied from Boston, I think), showing the premises inspected, the condition of the fixtures—whether "good," "fair" or "bad"—and the hour and minute of visit.

We have had cases arise, in disputed matters, where it has been very valuable to refer to the exact hour and minute of the inspector's visit. Where fixtures are found leaking or out of repair, he fills out a waste notice blank which is mailed to the owner or agent, or left at the premises, whichever is the more convenient.

In the house-to-house inspection, every fixture recorded is checked as examined, and all changes found are noted *in pencil only, as no ink entries are allowed by inspectors.* Where additional fixtures, etc., with additional rates, are found, which have not been previously reported by plumbers, the same are entered in their proper places *in pencil,* and also a special report on a slip made to the office for billing.

When an inspector completes a section, he returns the book to the office, where all pencil charges, etc., are duly noted and *entered in ink,* leaving the book all ready for the next time. In entering changes on these books, *no erasing is allowed,* but, when necessary, old rates, etc., are crossed off *in red ink* and new entries made above, thus showing a complete history of all changes

from the first. When a book becomes too full or mixed up a new one is written with detail rearranged, and the old one kept on file.

We find that this system works very well with us in Springfield, but perhaps some of the other gentlemen present have methods which are far better. I shall be pleased to answer any questions which any member would like to ask, and to show these books and slips to any one wishing to see them.

THE PRESIDENT. Mr. Allis may have some suggestions to make on the topic.

MR. ALLIS. Mr. President, I don't know as I have anything to say which will be of interest. Mr. Hathaway uses about the same sort of book that we have. We have a book about three-quarters of an inch thick, and we file away those books, taking new ones each year. We have pretty much the same arrangement he has; we have the service, and the number, and the street—our services are all numbered in consecutive order, so the service number is a thing by itself—the owner's name, tenant's name, and the series of columns for bath tubs, faucets, &c. Then these are all copied on to a large book, so it will show the state of things for three or four consecutive years.

We have experienced a good deal of trouble in getting the plumbers to give us any idea of what they are doing, and we have only been able to find out what changes have been made, in many cases, by inspection. Now, by a late ordinance of our Common Council, the plumbers are obliged to give us a report of every change they make. We have also a new arrangement with the Inspector of Buildings. He gives us every week a list of all the applications for permits to erect new buildings. We have what we call a yearly inspection which is about the same as keeping one man inspecting all the time, and keeping him busy, and it pays. One inspector last year found two thousand dollars worth of water unaccounted for, that we would not have got at unless we had an inspector looking right after it. We find this is especially so in the use of hose. We have a separate rate for hose. When the bills are sent out it is assumed that if a man has a hose the previous year he wants the hose this year, and the bill is made out three dollars additional for the hose. But it often happens that when a man comes to pay his bill he will say: "I am not going to have any hose this year, and you must abate that." So the three dollars is abated and he pays the rest of the bill, and we notice he never comes in to tell us when he concludes afterwards, that he will use the hose after all. Human nature is such that some men think it is perfectly right to cheat the city if they can; so we send men around in the evening to see who are using hose, and it quite frequently happens that some of those very people who have had their bill abated finally walk in and pay up and pay as they did the year before.

MR. CHASE. We don't have very much trouble in Taunton with the plumbers, for this reason: A plumber cannot do business with the water works unless he has a license from the water commissioners, and they give that license when the plumber files a bond of five hundred dollars, and then the water is not turned on in any place till the water rate is paid in advance, and the plumber's return is in, so that the owner has as much interest as anybody else

that the plumber's return shall be made to the office. We know just what fixtures are there before the water is turned on.

MR. WINSLOW. Suppose it is simply an additional faucet?

MR. CHASE. The plumber hasn't any right to make any addition unless he has applied to the water works' department for permission to make that extension. We give him that permission as a matter of course, but we know what the fixture is and charge for it. The mason makes a deposit of three dollars in advance before he commences work, and then we charge him at the rate of six cents a barrel for every barrel of lime. When he comes to settle he reports how many barrels were used, and we pay him back the balance.

MR. HOLDEN. We used to require masons to make a deposit, but some of them never had so much money ahead, and for that reason we gave it up. There were some masons, of course, who were honest and ready to pay their bills, but there were others from whom it was very difficult to collect anything; and some two years ago, at the time we changed our water rates, we provided that all water for houses in process of construction would be charged to the owners direct. For the ordinary cottage house we make a bill of a dollar and a half for lime purposes to the owner; if it is a two story house, a charge of two dollars; and larger houses accordingly. As soon as the supply pipe is put into the house we send the owner a bill for the connection, for the cost of putting in the supply pipe, and also for lime purposes, and we find we collect a great deal more money in that way than we did when we undertook to collect from the masons.

MR. BEALS. I would like to inquire of my friend Chase, how they get at it in case a plumber surreptitiously adds a faucet or two or three faucets?

MR. CHASE. We get at that by an inspection.

MR. COGGESHALL. We have an inspector on duty all the time, and he is supposed to cover the entire city at least once during the year, and that guards against the trouble which Mr. Beals speaks of; for every year we find enough additional fixtures for which we charge for the present year and the previous year, to more than cover the inspector's salary every year. I would say that the first thing our inspector does when he enters a house is to go into the basement and go to the inside shut off and place there a waterphone and try for leaks; if he finds there is a leak the next thing to do is to locate it; and he inspects every fixture in the house.

MR. ALLIS. I would be very much obliged if our secretary would tell us about a waterphone and what it costs.

MR. COGGESHALL. The easiest construction is a short piece of common steel rod, with a little bell on one end of it which you put to your ear, and put the other end just on the shut off, and if there is a leak there you will hear it.

MR. HATHAWAY. We are obliged under the Commissioners rules, to inspect, if possible, every fixture in the city once a year, but of late years we have not been able to accomplish this. We have had but one inspector that could attend to the house to house inspection, and then only for part of the time, and before this spring we were making but little progress in this direction.

In order to explain to the Commissioners why we had not covered the territory this last year, in my report to the Board, I divided up the inspection in detail, as follows:

"Inspection of new buildings for fixtures, dates of occupancy, &c., monthly or oftener." "Inspection of vacant tenements." We make an allowance for vacancies reported at the office, *from the date of the notice*, and it takes one man's time for about ten days in every month, to look up the dates of re-occupancy, *invariably not reported* at office. "Inspection and reading of meters." We read our meters once a month. Then we have inspection of hose use, where water is taken for other purposes, also. This is done all through the summer season, at favorable times. We do not bill the hose until the end of the season, and then only on evidence that it is actually used, or the parties admit that they are going to use it. (Where water is taken for the use of hose alone, we turn the supply on in the spring and off in the fall.) Then we have a special semi-annual inspection of manufacturing premises previous to regular billing. And so the time has been divided up in this way, heretefore, leaving but little time for the house-to-house inspection with our present help.

I might say in regard to the books previously described, I have heard the objection raised, that when one book is out it cannot be used as a ratebook in the office, but as we replace them so often, and as a book is out but a short time, we have one of the preceding set in the office, that we can use for a day or two while the other is out.

SPECIMEN OF SPRINGFIELD RATE AND INSPECTION BOOK.

July 17, 1891. BUCKINGHAM STREET.

No.	NAME AND USE.	DETAIL.	TOTAL.	LOCATION OF FIXTURES AND REMARKS.
95	Stanton James E., Frary Oscar L.			
	1 Family,	8		1st floor—2 set tubs, 4 faucets. " " —1 sink, 2 faucets—1 set bowl, 2 faucets—H.W. Boiler.
	1 Bath Tub,	4		2nd " —2 faucets—1 set bowl, 2 faucets.
	1 Water Closet,	4	16	" " —"Pan," with tank.
	Hose, See "Hose Book."			1 Sill cock.
117	Johnson Frank W., (Dr.)			
	1 Family,	8		Basement - 2 set tubs, 4 faucets. 1st. floor—H. W. Boiler—1 sink, 2 faucets—1 set bowl, 2 f.
	1 Bath Tub,	4		2nd " —2 faucets,—1 set bowl, 2 faucets.
	1 Water Closet,	4	16	
	1 " " (cut off.)	2	18	" " —"Hopper," with tank. Cellar " self-closing hopper cock cut off.
	Hose, "See Hose Book."			2 1 Sill cocks.

Words underlined crossed off with red ink.

REPORT OF THE COMMITTEE ON CLASSIFICATION OF RATES,

BY

J. C. WHITNEY, Registrar, Newton, Mass., Chairman.

Mr. J. C. Whitney, for the committee appointed to consider and report upon "Classification of Rates," submitted the following report:

Mr. President and Gentlemen of the Association; your committee appointed at the meeting in March, 1890, to consider and report upon Classification of Water Rates, having considered the same, respectfully report that they believe that the rate charged for each fixture should be based upon the quantity of water used by it, if that quantity can be ascertained. This your committee has endeavored to do by using results obtained from meters already in, and by setting special meters in cases where the fixtures were not already covered. While the results obtained are not fully satisfactory, still your committee believes the method employed to be the correct one, and that any conclusions arrived at in the future will be from investigations pursued on this same line. No attempt is made to recommend a fixed standard rate for the first faucet, as of course this rate must vary in accordance with the conditions under which different water works are operated. All the committee has endeavored to do is to ascertain the amount of water used by the average family from the first or kitchen faucet, and to base the rates for all other household uses on this standard.

In arriving at this standard amount used by each family from the first faucet, your committee has taken the average amount used by 619 families, embracing 3000 persons, and divided according to the sizes of the families, as follows :

No. of Families.	Persons in each.	Total No. Persons.	Average Consumption per Annum. (Gallons.)	Average Daily Consumption pr. Capita. (Gallons.)
31	2	62	8,060	11
116	3	348	9,733	9
153	4	612	10,919	7.5
144	5	720	12,046	6.7
92	6	552	14,114	6.4
36	7	252	14,593	5.7
12	8	96	15,150	5.2
25	9	225	15,738	4.8
7	10	70	18,166	5
1	18	18	41,888	6.4
1	20	20	79,288	10.8
1	30	30	58,344	5.3
619		3,005		

It will be noticed that the average family consists of almost exactly five persons. This average family used during the year from the first faucet 12,046 gallons, and this amount has been used as the standard on which the amount charged for other fixtures should be based.

MR. BILLINGS. The figures you have given are for the first faucet?

MR. WHITNEY. These are for the first faucet in the house, the kitchen faucet. The meters which were set covered houses where the family use consisted of simply one kitchen faucet.

SECOND FAUCETS.

The five special meters which we had set on the second faucet showed the use to range from 22 to 6 per cent., the average being about 14 per cent.

This figure seemed rather low, and of course it is possible, so few cases having been covered, that the average in a larger number of cases might differ somewhat from this, and your committee feel therefore that a rate of 20 per cent. for the second faucet, that is 20 per cent. of the amount charged for the first faucet, would be a fair one.

FIRST BATH-TUB.

The amount used in bath-tubs ranged from 40 to 90 per cent. of the amount used in the first faucet, with an average of 70 per cent. Seventy-five per cent. makes an even figure, and your committee recommends that 75 per cent. should be charged for the bath-tub.

SECOND BATH-TUB.

The second bath-tub we were not able to cover in a satisfactory manner, but we see no reason why the water used in two bath-tubs should be much in excess of the amount used in one, but some charge should certainly be made for it, and so we recommend as a rate 15 per cent. of the amount charged for the first faucet.

FIRST WATER CLOSET.

We covered eight water closets with special meters, and were able to get fairly reliable data from thirty-seven more. In these cases the average amount used was 86 per cent. of that drawn from the first faucet, ranging from 25 to 150 per cent. The largest amounts were undoubtedly caused by leakage to some extent in the fixtures. It is quite evident that when the perfect ball-cock and closet-valve are invented, and when people refrain from allowing the water to run occasionally to prevent freezing, or for the purpose of giving the soil pipe an extra flush, the price charged should not exceed 50 per cent. of the faucet charge, but at this date 90 per cent. is probably not far from correct.

SECOND WATER CLOSETS.

No very satisfactory results were had from the second water closets in the house. The three which were covered used a very small amount; possibly they were exceptional cases. It it difficult to say whether they were or not. The use, however, must be small, just as in the case of second bath-tubs, and it is quite safe to say that the amount of water actually used in two closets in

a house does not differ very much from the amount used in one closet; but the factor of waste comes in here, which is undoubtedly quite a considerable item in the case of water closets, and if we fix the price of this second closet at 40 per cent. of the faucet rate it would be no more than fair, about 32 per cent. being allowed for wastage and 7 per cent. for actual use.

MR. MEYER. May I interrupt to ask how the water closets are supplied?

MR. WHITNEY. Some are supplied by ball-cock flush tank, and others by direct pressure, and all have self-closing attachments.

MR. MEYER. Are these figures on the tank supply or on the direct pressure supply?

MR. WHITNEY. They are on both, and the results we found varied very little.

MR. MEYER. You mean they have something you have to hold on to while flushing?

MR. WHITNEY. Yes.

MR. MEYER. Then you don't get the same flush you would from the tank?

MR. WHITNEY. You don't get so thorough a flush?

MR. MEYER. Does the overflow run into the down-pipe of the closet?

MR. WHITNEY. Yes.

MR. MEYER. There is no independent overflow?

MR. WHITNEY. No independent overflow, no sir.

MR. MEYER. Then if the ball-cock leaks there is no incentive to have it repaired?

MR. WHITNEY. I should say not, except that in Newton, everything being covered by meters, there are very few inducements for takers to waste more water than is absolutely necessary.

SET-TUBS.

The water used in set-tubs varied from 25 to 55 per cent. of the faucet amount, with an average of 35 per cent. It would be hardly fair to assess this figure, however, as the water would be used for the family washing, whether the house was supplied with set-tubs or not, and nearly the same amount of water would be used even if drawn from a faucet and carried to the tubs. There is very little wastage from this fixture and your committee recommends that the percentage for set-tubs be made the same as the second faucet in the house, that is 20 per cent. of the first or basal faucet.

HOSE.

We had eighty-five cases of hose covered, but on account of the wet season the quantity used proved to be very small indeed, averaging only 56 per cent. of what was used from the first faucet. Taking into consideration the rather exceptional season, it certainly would not be safe to put the figure much if any less than for a water-closet, that is 90 per cent., which, perhaps, is somewhere near right.

The foregoing cover almost every common household use, but some experiments were made on stores, stables and various uses, and perhaps the results obtained may prove interesting.

STORES, ETC.

Groceries,	for	faucets,	75	per cent. of	family rate.
Dry goods,	"	"	50	" "	"
Markets,	"	"	75	" "	"
Dentists,	"	"	75	" "	"
Barbers,	"	"	75	" "	"
Fish markets,	"	three times the		"	"
Photographers,	"	"	2½	" "	"
Druggists,	"	same as family.			

Water closets in all above cases to be charged the family rate.

SCHOOLS.

Water used for drinking purposes, for each 200 scholars, the faucet rate; for water closets, three times the private family rate.

CHURCHES.

For faucets, water closets and hose, 50 per cent. of the private family rate.

STEAM BOILERS.

Steam boilers running 10 hours per day per horse power 130 per cent. of the family faucet rate.

LAUNDRIES.

All we were able to cover were those of the Chinese variety, and it was considered best to have the rate based on the persons employed, for the Chinamen are not very apt to waste time, and the laundry is kept running as nearly 24 hours per day as is possible. For each person employed, the rate should be at least three times the family rate.

GREENHOUSES.

Vegetable, for forcing, for each 1,000 square feet of glass 85 per cent. of the faucet rate; for raising flowers, each 1,000 feet, same as faucet rate.

STABLES.

In livery stables an attempt was made to ascertain the proportion of water which was used for drinking by the horses and that used for washing carriages; it was found to be about 22 per cent. for drinking and 78 per cent. for washing. Also we endeavored to find how much saving was effected in carriage washing by dispensing with hose use. This saving was found to be some 30 or 40 per cent. Your committee would recommend a rate on livery stables for each horse, not including washing carriages, of 20 per cent. of the faucet rate; for each horse, including washing carriages without hose, 50 per cent. of the faucet rate; for each horse, including washing carriages with hose, 75 per cent. of the faucet rate.

Private stables, including washing carriages with hose, each horse the faucet rate.

Team stables, including washing with hose, each horse 33 per cent. of the family rate. Of course there is very little careful washing done on this class of teams, which accounts for the small amount to be charged.

Cattle stables, each animal 16 per cent. of the faucet rate.

These figures cover all the uses regarding which your committee were able to get any information.

There is one thing I have omitted, and that is with regard to the charge per faucet and for other uses in families larger than five, the number five having been taken as the basis in the figures which have been given. While we acknowledge that some small families are large users, and some large families are very small users of water, still, the average large family uses more than the average small family, and in fixing rates we have to base them on averages. Now, we find that the amount used above five increases at the rate of about 7 per cent. for each additional person in the family. It would, perhaps, be better to make an even figure, and call it 10 per cent., so after fixing your rate on the first faucet for five persons, for each additional person add 10 per cent. on both the first and second faucet, and on bath-tubs, closets and set-tubs. Of course, the rate for hose would not be affected.

MR. BILLINGS. I would like to ask Mr. Whitney for information on one point. I notice the committee is made up of members from three different places—Newton, Fall River and Worcester. Now Worcester, Newton and Fall River are very different cities in their character, and data obtained from one would be hardly fair for another. I would like to ask Mr. Whitney how these figures, which he has so ably presented, were made up.

MR. WHITNEY. These figures were based entirely on Newton, but I think it can be assumed that where there is a waste from one class of fixtures in a town, there will be a corresponding waste from all the other fixtures, and where in another city, there is a small use from one fixture, the use from all the others would be in proportion.

While our use in Newton is small, I think the ratio runs through the fixtures. The figures for Worcester and Fall River would perhaps be larger, still, the waste would be large from the kitchen fixture right through the list and the *ratio* would be the same.

MR. HOLDEN. I would like to ask what disposition is made in Newton of the water after it goes through the faucets, whether it goes into sewers, dry wells or on to the surface?

MR. WHITNEY. There are no sewers in Newton; some are being built, but none in operation. We have to depend on cess-pools to get rid of the water, but a large part of the town is built on a coarse gravel, which takes water away very rapidly indeed, and a comparatively small per cent. of the people are troubled with the cess-pools filling up.

MR. HOLDEN. That in my opinion would make a vast difference, because where a person has a dry well or surface drainage they are usually very careful about using water. Where the water runs into a sewer, take it especially in tenement house localities, there is likely to be an extravagant use of the water

and a continual waste, particularly in the winter time to avoid freezing, unless it is looked after very closely. And it seems to me that in a city like Fall River, where there are plenty of drains, there would be a marked difference in the results there from what was found at Newton. It is not so much the amount of water that is used for domestic purposes that we look after as it is the waste. Several years ago I made a series of experiments on a small scale in regard to that, and I found that the cheap tenement houses had very poor plumbing fixtures, the cheapest kinds of water closets, and that they used a great deal more water than they did in the better class of houses where they had all the necessary fixtures, and where it was policy for the owners to keep them in good shape.

Mr. W. M. Hawes. As this is a very important subject, and as Mr. Whitney seems to have given a great deal of time in looking it up, and as there are a great many figures that we cannot remember, I would move that the Secretary have a sufficient number of copies of the report printed, to provide three copies for every member of the Association.

Adopted.

The President. It seems to me that we should feel deeply indebted to this committee for the very careful and large amount of work they have put into the study of this question. They have begun, I believe, in the right way, and, although their work has been done over a limited field, yet I feel that it furnishes a unit upon which to continue the work. In order to answer the questions that have been raised, as to whether in other cities the conditions would not be different, it seems to me that this work should be continued, and should be continued by co-operation upon a plan which may be outlined by this committee; that this committee be continued if in the opinion of the Association it seems wise. There is scarcely one of us but what would be willing, for the benefit that would thereby be derived, to lend his co-operation to the accumulation of information upon this subject. It may be asking too much of this committee to continue the work, but I think the results will more than justify the labor put into it; and I would suggest for the consideration of the Association the propriety of continuing the committee with the understanding that every member of the Association will volunteer to co-operate with the committee and furnish them such details as he may be able to obtain from his own works.

Mr. Billings. I was on the point of making some such suggestion as you have just made, Mr. President. It occurred to me that so handsome a piece of work as has been presented by this committee ought not to be allowed to pass without some notice, and I was going to move the acceptance of the report, which would nominally discharge the committee, but I am very glad to adopt your suggestion. I feel like saying just at this point, however, that to my mind the value of this report lies not so much in the actual figures presented as in the method which has been shown, the careful systematic study and broad way in which the subject has been attacked. I think it will not do to lose sight of the fact that Newton is one of Boston's suburbs, that it, as I understand it, contains practically no tenement houses, practically no factories,

and almost no stores, as compared with Fall River or Worcester and many other places, and that the actual percentages given would probably not hold anywhere except in a suburban city. But the method followed by the committee will hold anywhere, and it is admirable beyond my praise, and I hope the committee will be continued, and that arrangements will be made so that this work so handsomely begun may go on. If it is proper, I will move that the committee be asked to continue their labors with a view of carrying out the work.

THE PRESIDENT. In putting the motion I desire to express the wish that every member will supplement his vote by pledging himself individually to assist the committee. I know from my official relations with Mr. Whitney that he has been somewhat restricted in his investigations by a lack of information from outside places.

The motion was adopted.

MR. ALLIS. I would suggest that the committee furnish us with certain questions which they would like to have us answer, for I think we would all like to assist the committee if we only knew what was wanted.

MR. WHITNEY. I will say for the committee that the results obtained from meters covering any sort of fixtures would be very acceptable. The figures presented in this report are based upon the results obtained in one place, and, possibly, as has been suggested, the results in other places might be found to differ considerably from these. The more information we have of course the better the results.

THE PRESIDENT. I assume in continuing the committee that the committee will have the co-operation of all the members of the Association, and that the committee from time to time, as it continues its study of this question, will formulate questions that they wish to have answered, and that they will be sent out to the members by the Secretary. Unless it meets with the disapproval of the Association I would so assume.

MR. BEALS. Why might it not be well in sending these copies of the report to the members to set apart a page for the questions, and then the report itself will call to mind the subject, and the questions would be brought to the attention of the members directly in connection with the report?

THE PRESIDENT, I think the suggestion is a good one, and I have no doubt the committee will profit by it.

MR. ALLIS. I think we have all been very much interested in this report, and it is a very valuable one. At the discussion on this subject at a former meeting I think many of us were surprised to see how the rates differed in different places.

MR. BRACKETT. In considering this question I think one fact should be borne in mind, and that is that Newton is almost entirely metered, and the results obtained there would probably have a much greater uniformity than would be shown by figures obtained in places which are not so generally metered. I know that in a block of moderate class brick dwellings in Boston, which were metered more for experimental purposes than anything else, in

fact they were not charged at the meter rates, although the buildings were occupied by the same class of tenants, the quantity of water used *per capita* varied, as I remember it now, from about 25 gallons to 200 or 300 gallons per day. Of course the excessive amount of two or three hundred gallons was owing to defective fixtures. I do not think the results will follow in the same proportion or ratio where the premises are not metered, for the reason that the first faucet, or sink faucet, is much less liable to waste than the water closets. The water closets would be the principal source of waste, and unmetered premises for that reason should be charged a much larger percentage of the first faucet rate; so results if they can be obtained by applying meters to premises the occupants of which are still charged at schedule rates will, I think, give more valuable information than results obtained from metered premises.

MR. WHITNEY. I think you will find that if meters are set on premises where the occupants have been paying schedule rates, the takers would immediately suspect an attempt was being made to increase the rate, and would probably look after the fixtures immediately.

MR. ALLIS. Our Water Board have had to wrestle with this rate question for the last two or three years, and some of them had meters put into their houses with the object of finding out what the relation between the meter rates and schedule rates would be. The houses were what we call $21 houses, that is, they had the regular line of fixtures allowed by the board, and to our surprise we found at the end of the year that the regular faucet rate and the rate by meters were very nearly the same, for we really thought that by using the meter they would pay considerably less. The families were not wasteful families, and we were quite surprised to find in each case that the schedule rates and the meter rates were about the same.

MR. WHITNEY. I will say that we have had about the same experience in Newton. The average income per service is almost precisely the same as it was before we adopted the general meter system, coming within 25 or 30 cents.

MR. MEYER. What has been the saving in waste?

MR. WHITNEY. That has been rather difficult to estimate fairly, because the principal waste in Newton has been for the use of hose on lawns, and ever since the meters have been attached, generally, since 1887, the summers have been exceptionally rainy; it can be said however, that the maximum daily consumption of 1886 has not since been equalled, though the takers have increased 35 per cent.

MR. BRACKETT. The amount of water used and paid for by meter in Boston is about 26 per cent of the total consumption, while the revenue is 40 per cent of the total, showing that for the unmetered water we do not receive anywhere near the meter rates.

THE PRESIDENT. I would ask Mr. Brackett if that is not qualified somewhat by the fact that your meters are put on to large consumers, manufacturers, and so on?

MR. BRACKETT. That would not affect the total amount of water used, whether there were a few large consumers or many small ones. My point is

this, that of the total amount of water used 26 per cent. is metered, and 40 per cent. of the revenue is received from that metered water. Of course there is this to be considered, that in any system there is a certain amount of leakage from the mains, and a certain amount of water used for public purposes, from which no income whatever is received, but still it would not make that difference.

THE PRESIDENT. I have thought, so far as my study and observation have gone, that a very much larger percentage of water is lost in the way Mr. Brackett speaks of, by way of leakage or wasting, from which the city receives no revenue, which is really money out, than we have supposed.

MR. W. M. HAWES. We have about 4,000 meters in use in our city, and our consumption *per capita* is as low, probably, as in any city in New England. We attribute the saving to the use of meters; and almost invariably, where we have watched it, the price by meter has been less than the price by the faucet rate. It is optional with the Commissioners whether a meter be attached or not. If we consider the parties are wasting water by the faucet, we have a right to order them to put a meter on, and we have done so in numerous cases where we thought they were taking advantage of the faucet rate, and it has almost always reduced the bill.

THE PRESIDENT. Are the meters put on at the expense of the parties or of the city?

MR. W. M. HAWES. At the expense of the parties, because we started that way, and it is hard work to change now.

MR. TAYLOR. I think the committee has gone to work upon this subject in precisely the right way. There is no doubt that water rates are made up in a haphazard manner. I do not know myself, and never knew, and perhaps no one else does, the proportions of water actually used by the different fixtures. But it has now come to this in New England, that a gallon of water has a certain value, whether it is to be used at the sink or water closet or bath-tub, or wherever it is used, and it must be sold at a uniform rate, and the amount of water used by each fixture should control the rate for that fixture, it seems to me. And, although the amount may differ in different places, as of course it will, a general average can be obtained which will be in the main correct, and that is all we can ever hope to obtain as a basis for faucet rates, and it seems to me that this subject should be developed in the way in which the committee has begun.

MR. W. M. HAWES. And yet this price must vary very much according to the value of the water works, and the cost of getting the water to the consumer. Of course it is the desire of all of us to furnish water as cheaply as it can possibly be furnished. If you have a gravity system, where all you have to do is to lay the pipe and whistle for the water and it comes down the hill to the consumers, they ought to have it cheap in proportion to the expense of getting it to them; whereas, if you have to pump by night and day at a large expense to give them the water they must pay more for the accommodation.

STANDARD FLANGES FOR WATER PIPES.

BY

FREEMAN C. COFFIN, Civil Engineer.

Although one of the minor details of water works construction, the drilling and fitting of flanged connections for water pipes, causes perhaps as much annoyance and delay as any other single part of the work.

It is more than likely that a majority of the members of this association have at some time been delayed and exasperated by the failure of a piece of flanged pipe or gate to connect properly, and those who have, will undoubtedly appreciate the motive which led to writing this paper, and sympathize with the desire for some means, if such can be devised, of reducing the evil to its smallest possible proportions.

In all connections of the main system of piping with pumping machinery, standpipes, reservoirs, wells, chambers and gates, there are necessarily some pieces of pipes coming from different establishments to be connected by means of flanges bolted together, and it is a lamentable fact that no two concerns make flanges just alike in all particulars.

Some firms have a standard for their own use in connecting their own work, but these private standards do not coincide with each other, and when we assemble the parts from the different makers, the result is anything but gratifying to the superintendent or engineer, who may be waiting for just that particular connection to be able to "start the pumps" or let water into the reservoir. Now this results, as we all know, in great confusion, delay and needless expense.

There are many varieties and degrees of depravity in flanges. By referring to the drawing, you will see on the sketch, drawings of flanges numbered two and three, showing two of the most common cases.

No. 2 occurs where a bend or branch or any piece not entirely symmetrical is to be connected to a pipe already in position, or that cannot be turned upon its axis.

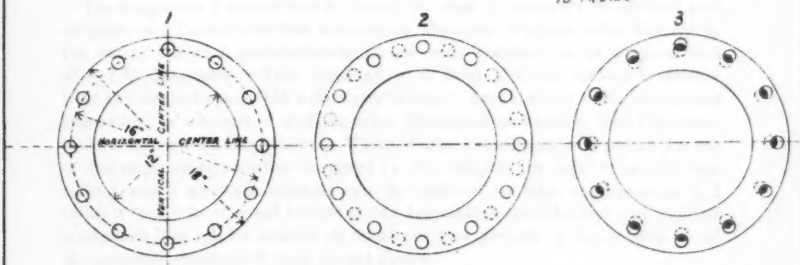
As you will see, the diameter of the bolt circle, and the number of the holes, are all right; the trouble is in the location of the holes; those in one flange are drilled with the centre line of the flange passing through the centre of the holes, while in the other the centre line passes through the space between the holes. A clear understanding in regard to the location of the holes with reference to a specified centre line, would have made a perfect connection.

As it is, we must send for a machinist and a ratchet drill, to drill an entirely new set of holes in one flange, at a serious expense of time and money.

No. 3 tells its own story, and is even *more* exasperating than the other; for it is so near and yet so far, and the holes must be cut out with a chisel, a job requiring time, skill and patience. As there is no recognized standard for the outside diameter of the flange, one often comes larger than the other, which makes a very unsightly job if exposed to view, as in an engine room.

STANDARD WATER PIPE FLANGES

FREEMAN C. COFFIN
10 TREMONT ST. BOSTON.



STANDARD 12" FLANGE — A COMMON OCCURRENCE where a branch or bend is to be connected — VERY PROVOKING

TABLE OF DIMENSIONS OF 6 TO 24 INCH FLANGES

INSIDE DIA. OF PIPE	OUTSIDE DIA. OF FLANGE	DIA. OF BOLT HOLES	DIA. OF BOLT CIRCLE	NUMBER OF BOLT HOLES	LOCATION OF BOLT HOLES
6"	11"	¾"	9½"	6	Center of bolt holes on vertical center line
8"	13"	¾"	11½"	8	" " " " " "
10"	16"	⅞"	14"	10	" " " " " "
12"	18"	⅞"	16"	12	" " " " " "
14"	21"	⅞"	19"	14	" " " " " "
16"	23"	⅞"	21"	16	" " " " " "
18"	25"	⅞"	23"	18	" " " " " "
20"	27"	1"	25"	20	" " " " " "
22"	29"	1"	27"	22	" " " " " "
24"	31"	1"	29"	24	" " " " " "

NOTE.

On horizontal pipes the vertical center line is the actual vertical line through the center of pipe in position.

On vertical pipes the location of vertical center line must be designated arbitrarily on drawing or sketch.

These proportions are not given as a correct standard but only as a suggestion.

It is needless to enumerate other kinds of failures, and no doubt you will agree with the statement that there are as many possible combinations of perplexities as there are kinds of flanges to be connected.

The only remedy for the trouble that has been tried, to my knowledge, is to leave one flange of a connecting set undrilled, which is only a "scribe rule" process, and still requires the ratchet drill, and further expenditure of time, muscle and money.

The suggestion I should like to make is, that a standard be devised and adopted, and I make it to this Association, because it seems to be directly in the line of the work undertaken by it, and also because, in the words of one of our Ex-Presidents, "This Association is both able and willing to wrestle with any subject connected with water works." And I would make the further suggestion, as a means of starting some discussion and action, that this Association confer with the American Water Works Association, and possibly some of the engineering societies in regard to the subject, in order to set the ball rolling, and if no other societies can be induced to take an interest in it, I think it would be of great benefit if *this* Association should adopt and publish a standard that can be used by its members and printed in the catalogues of the associate members if they should desire.

The persistent use of such a standard by the superintendents and engineers belonging to this Association, and with the weight of its official sanction, would soon establish it in general custom in New England at least.

Of course, as in the inauguration of any new thing, there would be some difficulties in the way. A standard that would be suitable for pipes having a pressure of 300 lbs. and under, to sustain, would not do for higher pressures, but as it is very seldom that we meet with pressures of over 300 lbs. in water works practice, it does not seem advisable to make two standards, as it might tend to confusion, whereas simplicity is to be desired in a matter of this kind, and the few cases of exteme pressure could be well treated as exceptions.

In designing flanges, the subject naturally divides itself into five lines of inquiry.

First, the number of the bolts. It is quite a general custom to use a bolt for each inch of inside diameter of the pipe under consideration; for instance, for six-inch pipe, use six bolts. This rule makes the distance apart of the bolts small enough to prevent springing, under ordinary pressures, if the flange is made as thick as it should be to meet other requirements of strength. Another reason in favor of this purely arbitrary number, is the ease with which it can be fixed in the mind; *i. e.*, one inch, one bolt.

The second item is the size of the bolts.

Theoretically the size of the bolts should be such that the total strain on the flange, (which is or should be the area of the inside of pipe X, the pressure in pounds per square inch) divided by the total area of the bolts, *at the base of the thread*, would be equal to the safe strength of the iron.

The above calculation of strain would be correct if the joint between the flanges was so made that no water could find its way between them.

On the above theory, the formula to find the safe size of a bolt, that is the diameter at base of thread would be where

a=area of inside of pipe,
d=safe dia. of bolt,
s=safe strength per sq. inch of area of bolt,
n=number of bolts,
p=pressure of water per square inch.

$$d = \sqrt{\left(\frac{a \times p}{n \times s}\right)} \div .7854$$

This formula applied to a 12-inch pipe under pressure of 300 lbs. per square inch, using iron for bolts of a safe strength of 12,000 lbs. per square inch, would give with 12 bolts a diameter of $\frac{9}{16}$" at base of thread.

But this is like a great many other things. The theory is all right if you are in possession of all of the data. It is very clear that in this case we are not so fortunate; there is one indeterminate factor which will upset the most careful calculation, and that is how hard will the nuts be turned up on the bolts. We evidently cannot know this, and so we are obliged to fall back on former experience and use what we know to be safe. Probably a $\frac{3}{4}$-inch bolt is about right for a 12-inch pipe, and it is the proportion most used. The bolt holes should be $\frac{1}{8}$-inch larger than the diameter of the bolt to allow a slight adjustment of the pipes.

Third is the diameter of the bolt circle. This is a question that will require some investigation before a standard is fixed upon, as it is one of the most important elements of the design, and one which causes much trouble at present, by lack of uniformity.

But if we use 300 lbs. per square inch as the limit of pressure, we can approximate closely the maximum thickness of the shell of the pipe, (which thickness of course must be provided for); then the space taken by the fillet, or the rounding of the corner between the shell and the flange, to prevent the casting from cracking in cooling, which it would be liable to do if left with a sharp angle, and one-half the diameter of the nut across the corners. The sum of these three amounts when determined, added to the inner radius of the pipe, will give the radius of the bolt-circle.

The fourth element is the outside diameter or radius of the flange itself. This should of course be large enough to completely cover the corners of the nuts, and to make a well finished job, there should be room to round the corner of the flange, perhaps to a radius of $\frac{1}{8}$ or $\frac{1}{4}$-inch.

The fifth item is the location of the bolt holes with relation to the position of the pipe, and this will always require the careful attention of the engineer in charge of the work.

The best way to locate them seems to be a specified centre line through the centre of the pipe and in the plane of the flange.

In all pipes laid in a horizontal position it is easily done by referring to a vertical centre line as shown on the sketch, but in vertical and oblique pipes, it would be necessary to refer to an arbitrary line (passing through the center

of the flange) on a drawing or sketch showing location of the pipes. This would make clear to the one laying out the flange the location of the holes with relation to any branch or bend in the pipe.

I think that some such plan as suggested would prevent much of the trouble and expense which is now caused by mistakes in flanges, and enable us to enjoy a little more of that peace of mind which all superintendents and engineers are so justly entitled to.

DISCUSSION.

THE PRESIDENT. The paper of Mr. Coffin is now open for discussion, and I presume he will be ready to answer any questions or to receive any criticism the members may wish to ask or to make.

MR. MEYER. I think if we heard from a representative of the founders, as to what, from their point of view, is necessary to do to bring such a reform about, we could get some definite idea how to proceed in getting united action.

THE PRESIDENT. Mr. Meyer's suggestion is certainly a practical and a good one.

MR. ALLIS. I had occasion to use flanged pipe some time ago, and I found the manufacturers had their own way of proceeding, as has been intimated. I found also that there is a very great lack of uniformity in a good many things besides flanged pipes—for instance, stop-cocks. It seems to me it would be a good idea also to secure uniformity in that direction, and also in hydrant openings and inlets. I think the suggestion made by Mr. Coffin is a good one, and I have an impression that the mode he suggests is all right, and that if you carry your ideas to the makers in good shape they will adopt them. I have been told by different manufacturers if they only know what we want they would be glad to make it; but they say the trouble is every man who comes to them wants something different.

MR. COFFIN. My intention was that the standard should apply to gates and hydrants, and anything connected with the system.

DESCRIPTION OF THE NEW HAVEN WATER COMPANY'S DAM AT WOODBRIDGE, CONN.

BY

LUCIAN A. TAYLOR, Civil Engineer, Boston, Mass.

Mr. President and Gentlemen: I have not been able, owing to press of business, to prepare a written paper; I will, however, give you a brief description, assisted by a very crude diagram, of this work. In the first place I will say that this reservoir is for an additional gravity supply, for the New Haven Water company, supplying the city of New Haven with water. The elevation of high water line is 157 feet above tide, that is the elevation of the roll-way. The top of the dam is 7 feet higher, 164 feet above tide. There are some rather peculiar features in the construction, as to the location and the material which was encountered. Before I describe that I will state that this is the

first of a series of five or six reservoirs to be built on the West River and its principal tributary, Sargent River. This is dam No. 1. The second one of the series is now being built upon Sargent River, about three miles further north than this present one. The first is a distributing as well as storage reservoir. It is proposed to draw water down to a level of about 25 feet below the surface, which will reduce the elevation to about 132 feet above tide, New Haven being at an elevation of from 10 to 40 feet.

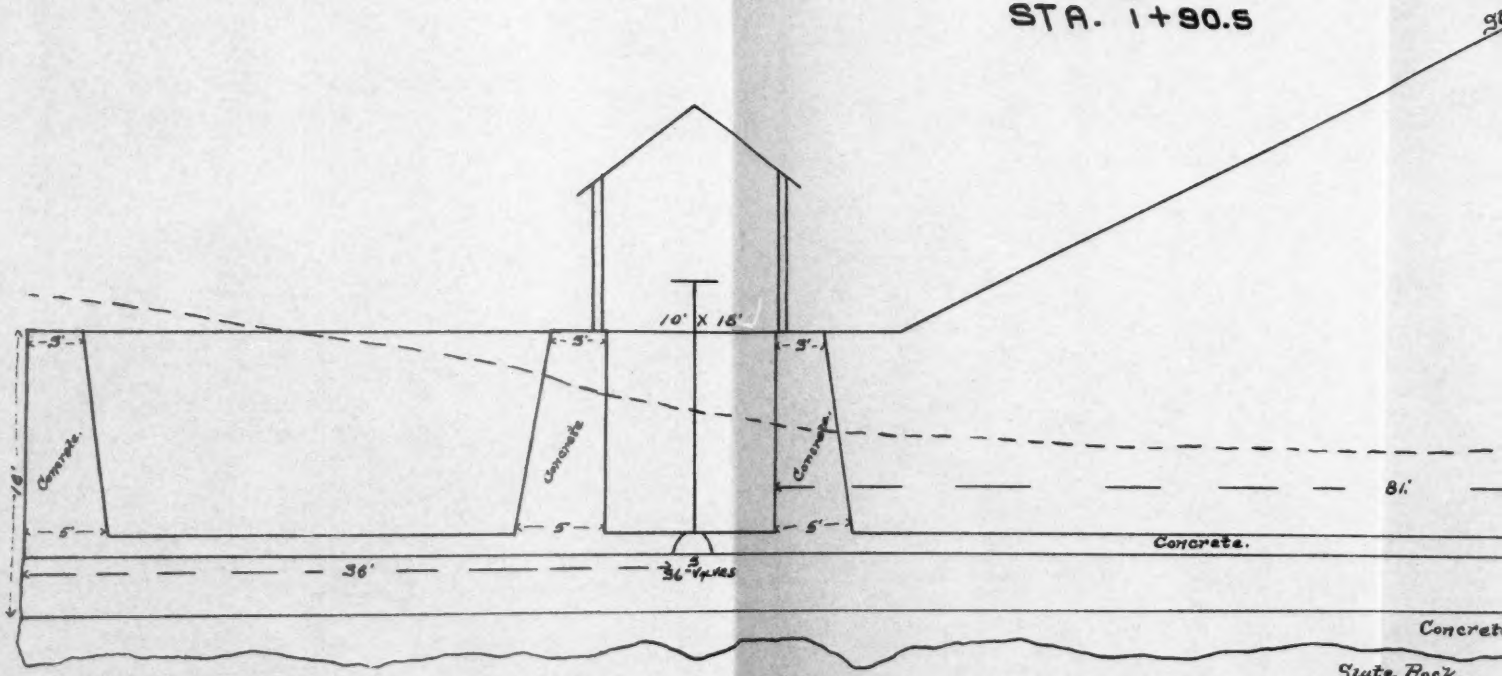
The length of the dam is about 1000 feet. For a short distance, about 300 feet, the dam is a considerable height, the high water mark being 46½ feet above the bed of the river. The material encountered on the westerly end is slate rock, interspersed with some veins of cement rock. In excavating for the main waste pipe line, excavations were made into the side of the hill, which is almost entirely of rock, horizontally about 30 feet, and vertically 20 to 25 feet. In this excavation were laid three lines of 36-inch cast-iron pipe, enclosed in a concrete masonry wall, and outside of that, extending at least 3 feet above, and 8 feet horizontally, were four cut-off walls, 3 feet in thickness. The excavation across the valley extended into this rock, from 4 to 8 feet in depth, and the main cut-off wall extended three feet below this line. This was done by blasting, and all the loose material was cleaned out so the trench varied in width from 10 or 12 to 16 feet, all the loose rock and material being carefully cleaned out, and the concrete filled up to the level with the top of the rock itself. From that point to a level with the top of the cut-off walls the concrete was carried up a uniform width of 8 feet.

In the construction of the pipe wall, which, of course, was one of the most important points in the whole dam, very great pains were taken. The rock is quite soft, and a great deal was shaken up by the blasting, and we excavated all the little pockets of loose rock that could be loosened by picks or bars, and consequently the whole bed of this pipe-wall was one series of irregular pockets, extending from 1 foot to 3 feet below the regular grade of the pipe-wall. It was to be expected that, unless extraordinary pains were taken, the natural veins of the rock running up and down the valley would allow water to percolate from the upper side of the dam to the lower.

As we came toward the old river bed we encountered a bed of clay, the surface of which extended just to the bed of the river itself. In constructing this portion, after the foundation was put in, approaching as near to the river as possible, a concrete wall was built up to some fourteen feet in height above the river, and the embankment formed also. We then built a dam further up the valley to turn the stream through the pipes, the only method of disposing of the water during the construction of the section across the river. At the same time excavations were commenced upon the easterly side of the river, and a bed of clay was encountered. We excavated through the gravel and clay to a depth of 48 feet below the surface, about 10 feet in length, and came to the rock bottom, 23 feet below the bed of the river. The bed of clay was of uniform quality, very firm and hard, and free from water. We encountered no water in the excavation excepting a little which dripped in from the overlying gravel bed.

Still farther east the clay nearly disappeared, and a bed of sandstone was

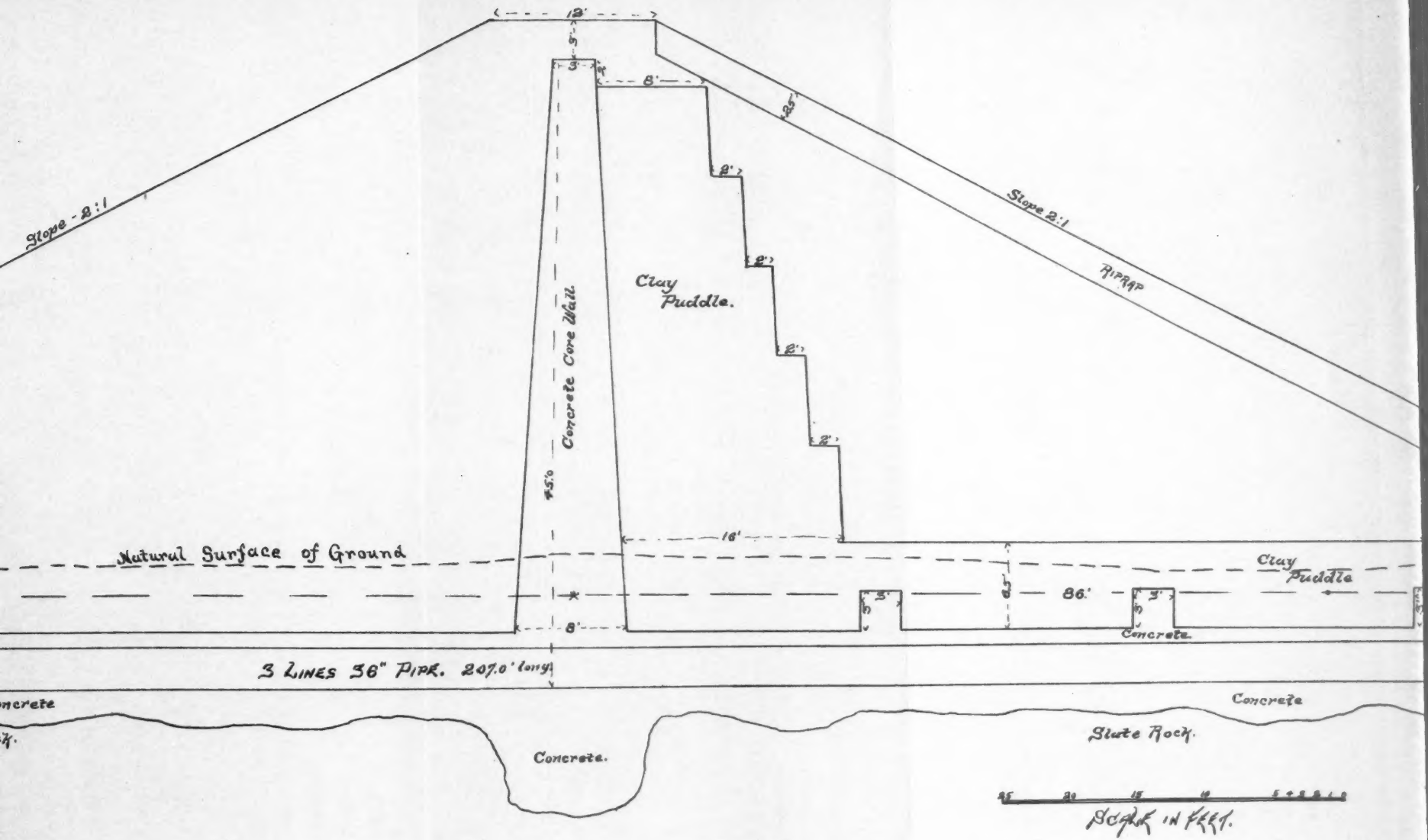
SECTION
AT
STA. 1+90.5

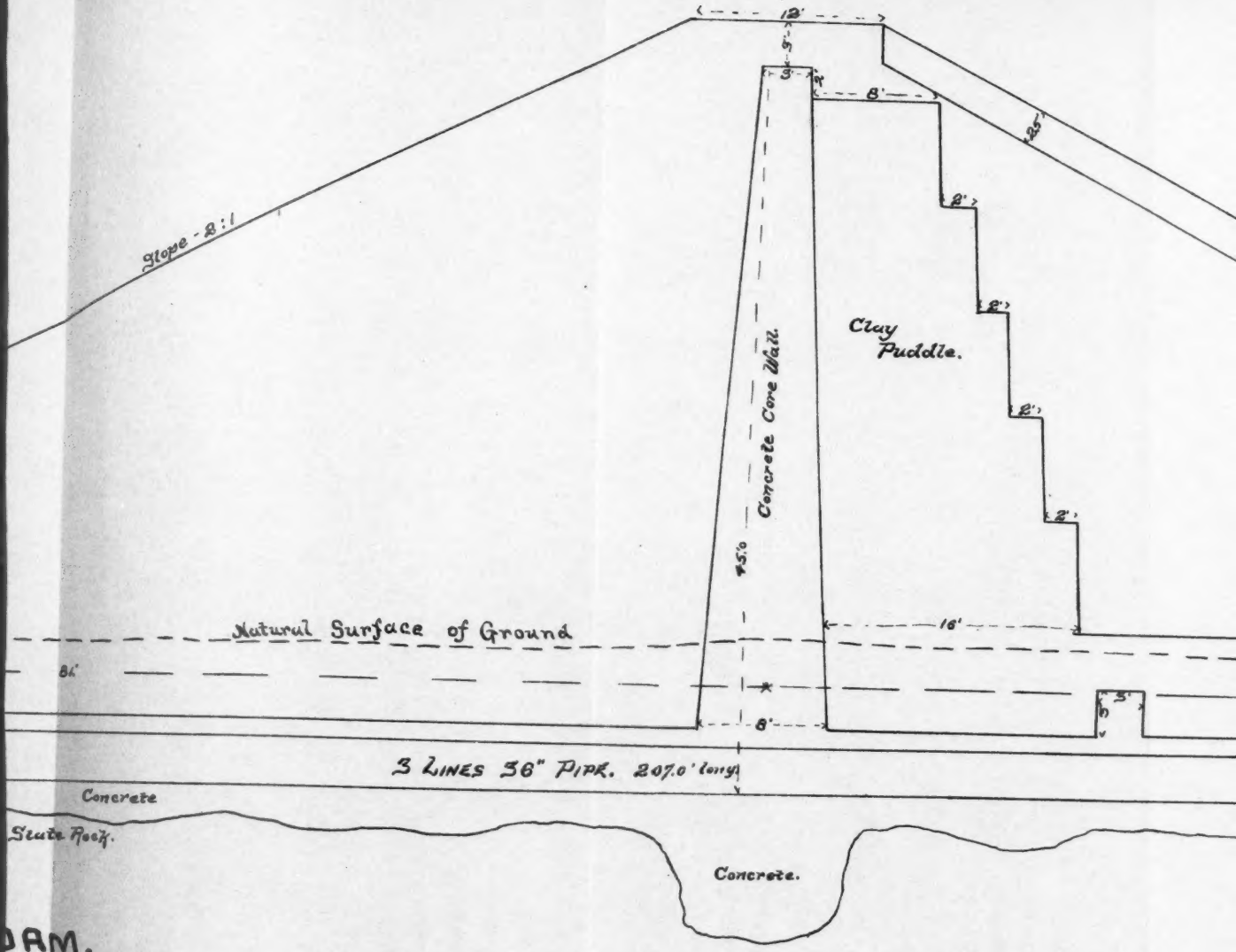


THE WOODBRIDGE DAM.

New Haven Water Co.

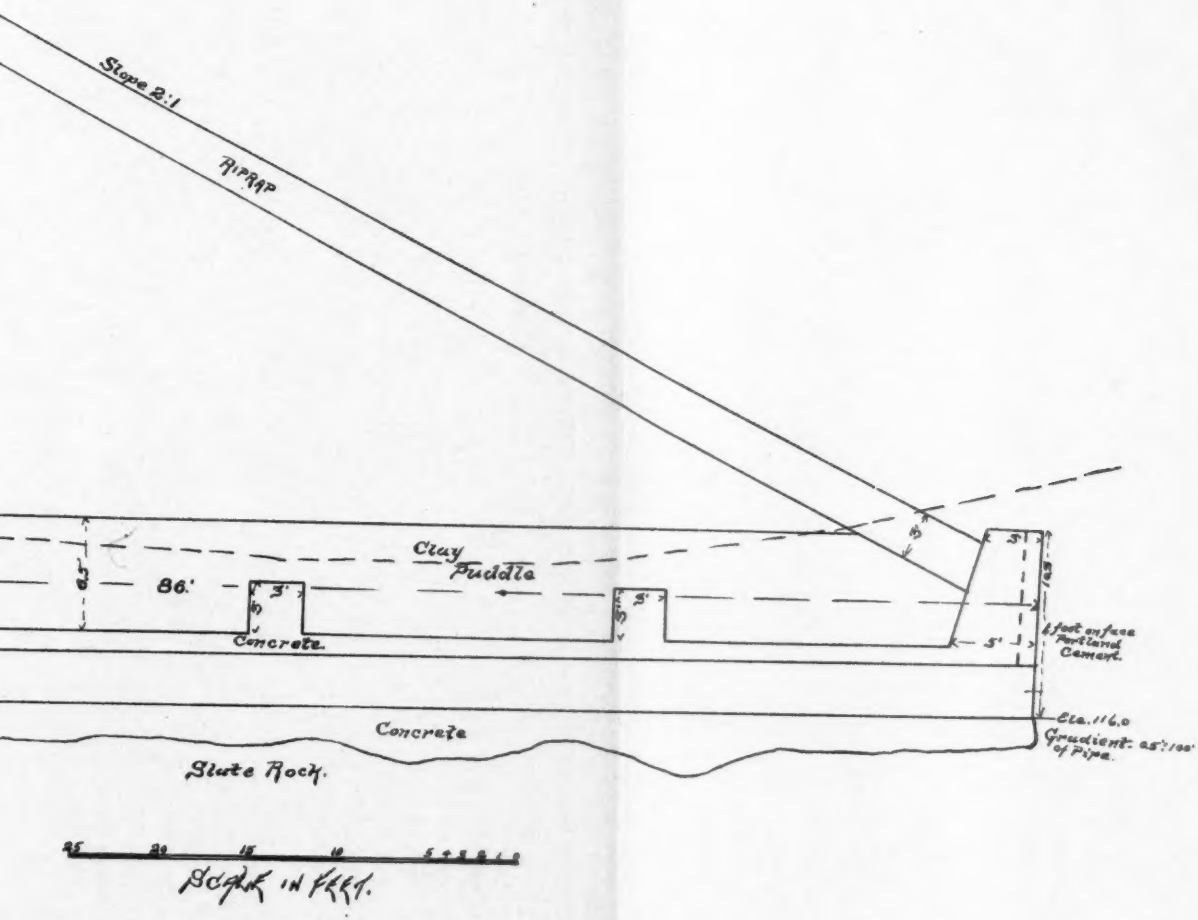
Lucian A. Taylor. Eng.


12'
3'
3'
8'
25'
Slope - 2:1
Slope 2:1
Rip Rap
Clay Puddle.
Concrete Core Wall.
75'0
2'
2'
2'
2'
18'
Natural Surface of Ground
Clay Puddle
3'
3'
45'
86'
3'
3'
8'
Concrete.
3 LINES 36" PIPE. 207.0' long.
Concrete
Concrete
Slate Rock.
Concrete.
SCALE IN FEET.


12'
5'
3'
1'
8'
2'
2'
2'
2'
2'
Slope - 2:1
Clay Puddle.
Concrete Core Wall.
75'0
Natural Surface of Ground
84'
16'
8'
3'
3'
3 LINES 36" PIPE. 207.0' long
Concrete
State Rock.
Concrete.

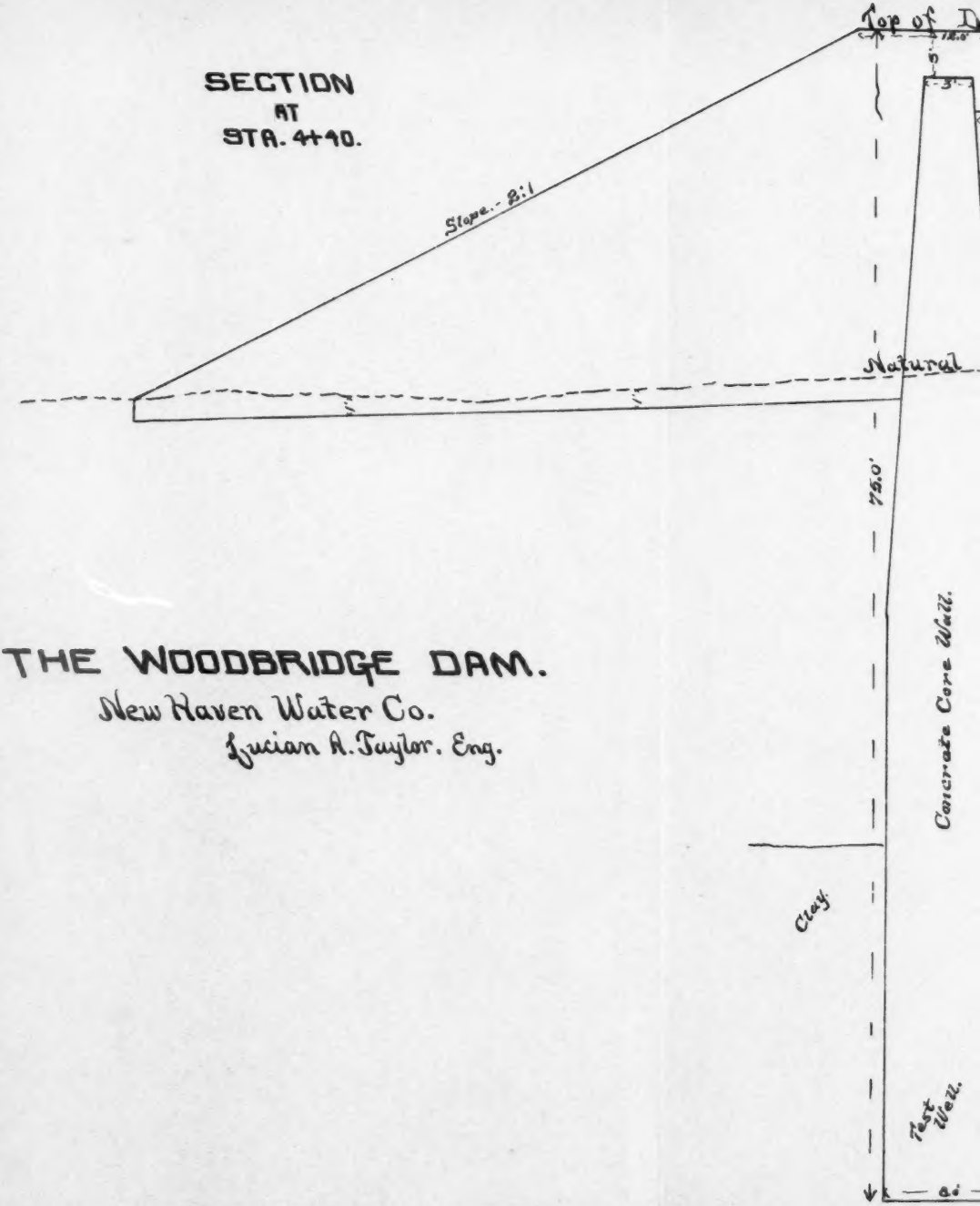
DAM.

Eng.



25 20 15 10 5 0

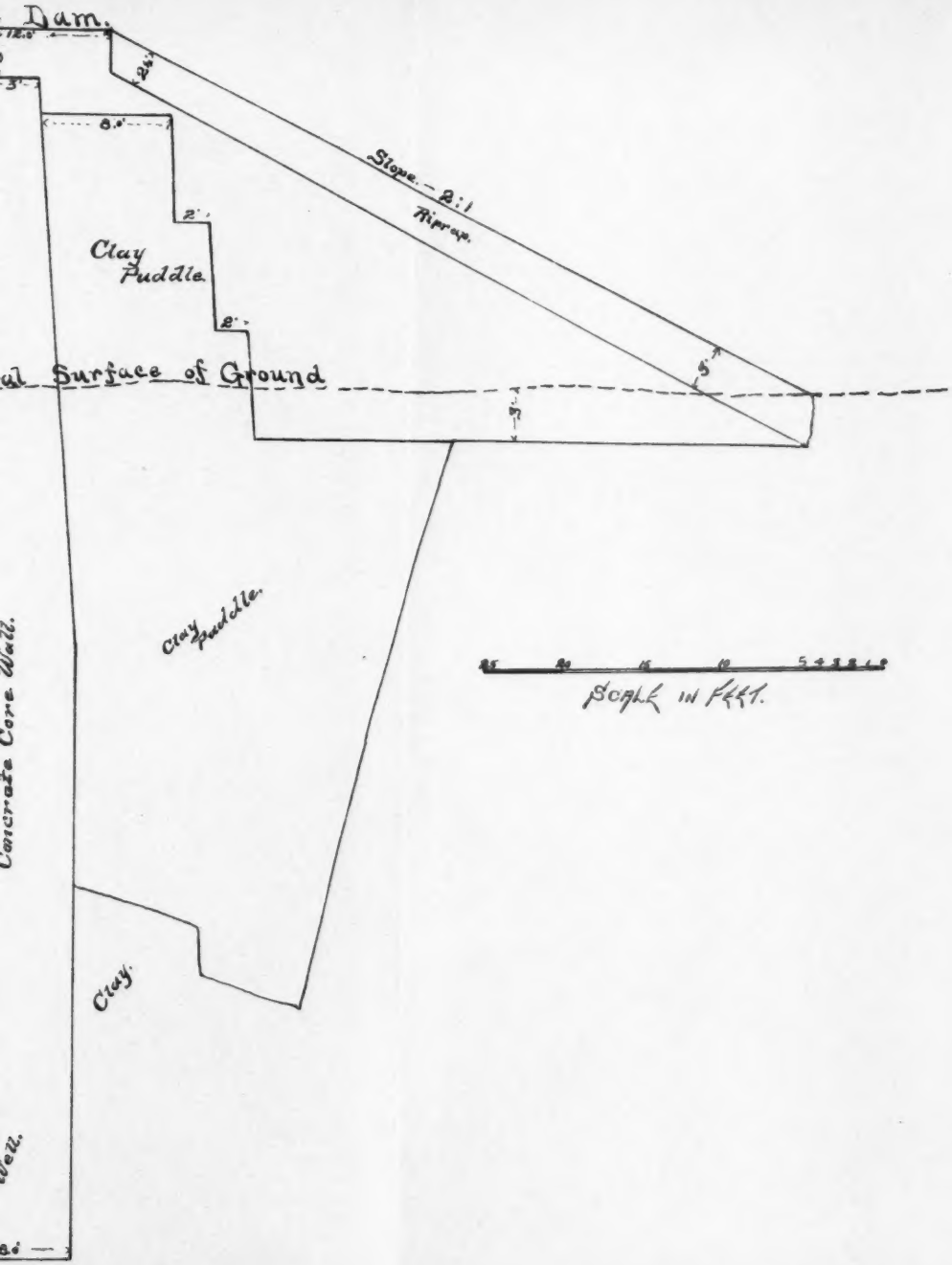
SCALE IN FEET.



THE WOODBRIDGE DAM.

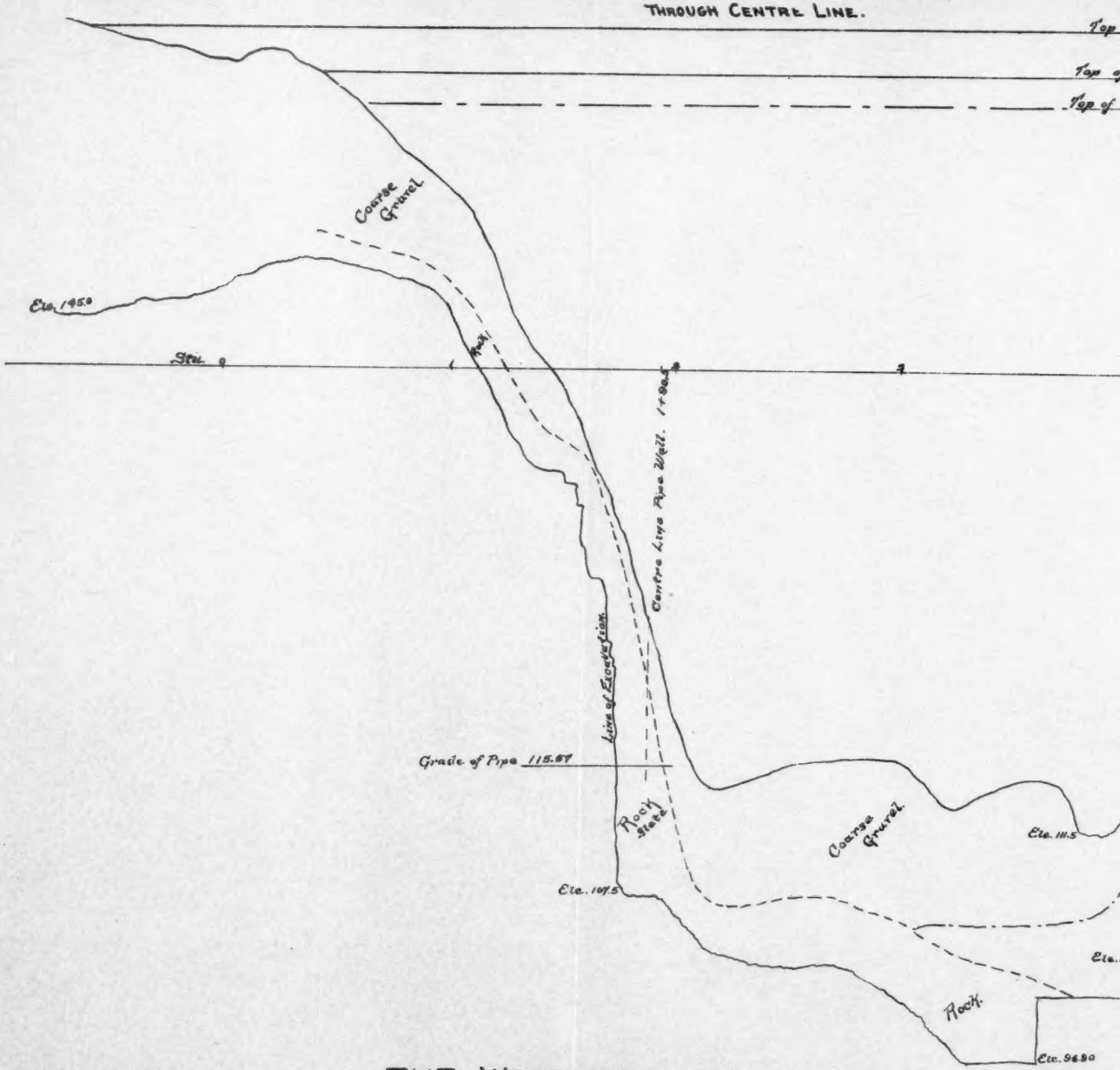
New Haven Water Co.

Lucian A. Taylor. Eng.


Dam.
Slope - 2:1
Riprap.
Clay Puddle.
Surface of Ground
Clay Puddle.
Concrete Core Wall.
Clay.
SCALE IN FEET.

LONGITUDINAL SECTION OF DAM

THROUGH CENTRE LINE.



THE WOODBRIDGE DAM.

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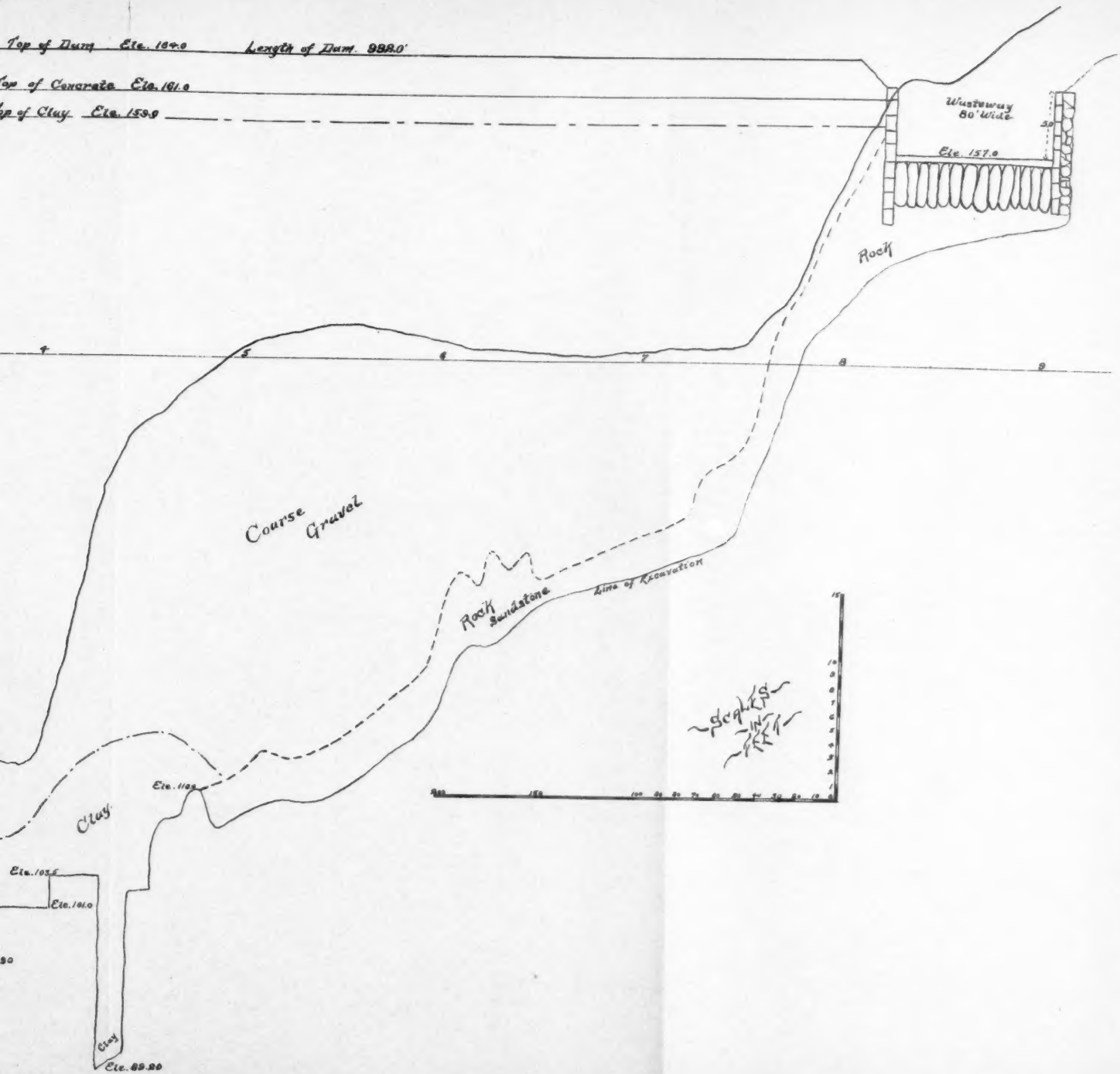

Top of Dam Ele. 164.0
Length of Dam. 988.0'
Top of Concrete Ele. 161.0
Top of Clay Ele. 153.9
Wasteway
80' Wide
Ele. 157.0
Rock
Course Gravel
Rock Sandstone
Line of Excavation
Clay
Ele. 110.0
Ele. 103.6
Ele. 101.0
Clay
Ele. 89.20
SCALES IN FEET

uncovered. Upon uncovering the river bed the clay was found to extend both up and down stream from the centre of the dam, and was not disturbed except to make a good foundation for the centre corewall, as I believed it was better than anything I could put in there.

The excavation, as we advanced further east, was made from 4 to 6 feet in the sandstone, and through the gravel bed overlying, from 16 to nearly 30 feet. Nearly the entire amount of earth between the top of the sandstone, and the surface of the ground was perfectly loose gravel, in almost all instances. Some small beds of fine sand were met.

The roll-way was first designed to be 50 feet long and afterwards was made 80, and 5 feet in depth. Afterwards the embankment was carried up 2 feet higher, so that the embankment is actually 7 feet above the high water line. I will say that the slopes of the dam, both inner and outer, are two horizontal to one vertical. The up-stream slope is covered with a layer of cobblestones of from 6 to 15 inches diameter, and three feet thick. In the excavations for the material for the embankment, great quantities of these stones were found, and they had to be removed from the material for the embankment, as no stone larger than 3 or 4 inches in diameter was allowed to go into it, and we not only had sufficient material for rip-rap, but also large quantities to waste besides. In excavating the channel for the waste way, which is some 700 or 800 feet in length, we found, fortunately, an excellent bed of clay, the same clay which we found in the river bottom, but there cut down to a lower level, and the gravel deposited on top. At the roll-way the clay came nearly to the surface of the ground, and extended up the slope still further.

In the bottom, above the main core wall, I uncovered the slate rock at least 16 feet in width. That portion was filled with clay puddle, and it was carried up to within 4 feet of the top of the dam.

I did anticipate there might be trouble with percolation through the slate rock, and took, as I thought, extraordinary pains with this construction. There has never been, so far as I have discovered, anything of the kind. Through the sandstone, a distance of about 270 feet, where the depth of the water is from 12 to 15 feet, there is considerable percolation underneath the concrete wall through the sandstone, notwithstanding the excavation of from 4 to 6 feet into it. I do not know the amount, but I know there is considerable percolation, and I anticipated it for the reason that the overlying material here is very porous, and the sandstone itself is porous. I have seen no indication whatever of any coming through from any point where the depth of the water is greater than about 15 feet.

I would say that in excavating on the upstream side of the concrete wall, we excavated into the bluff some 60 feet, and about 30 in width, parallel with the concrete wall, and that is filled with clay puddle. The clay puddle, as I say, was at no part at the base less than 16 feet in width; in the old river bed it was at least 40 feet, and bedded upon clay. The thickness of 16 feet is carried up to 24 feet below the roll-way, and 4 feet below the top of the dam the thickness is 8 feet, and the concrete wall 3 feet.

It was the first intention to take the supply pipes through an excavation in

the slate rock by two lines of 30-inch pipe. Afterwards it was thought, as a matter of economy, and also possibly of safety, better not to disturb the rock, so one of the 36-inch pipes was utilized as a supply pipe from the lower end, and upon the upper end a 30-inch pipe with screen on top was erected in the reservoir for a supply. So, at the present time, there are two 36-inch waste pipes, with a discharge also through the other 36-inch, by a 20-inch waste pipe.

During the year of construction the weather was exceedingly bad, and we had very numerous washouts. The stream is of the most violent character. As an instance, I will say some time in July the stream was running at the rate of about 9,000,000 gallons in twenty-four hours. We had an exceedingly heavy shower for a short time, and within two hours' time it was running at the rate of 400,000,000 gallons per day. We had also another rain in July that, as near as we could estimate, brought the flow of the stream up to as high as 1,000,000,000 gallons in twenty-four hours. That extreme flood lasted only for perhaps a couple of hours. This extremely bad weather delayed the work considerably, and also greatly increased the expense.

I presume numerous questions will occur to members, and I shall be very glad to answer any question that may be asked. I have been so busy that I have had very little time to give thought to this subject recently. I may state, however, farther, that the work was commenced in April, 1889, and finished in August, 1890, and it was done by day's labor under my personal direction.

One word as to the waste way, perhaps, will be interesting. Fifty feet down stream from the crest of the overfall we laid about 4 feet in thickness in cement, with large cobble-stones placed on end, that is, the longest end up. Fifty feet below that we laid the same way, except without any cement. I had one little experience at the upper end of the waste pipe wall which interested me quite a little, and the success was greater than I expected. I built a retaining wall of concrete at the upper ends of the pipes, and, wishing to turn the water into the waste pipe as soon as possible, built the outer foot of Portland cement concrete, and plastered with Portland cement. The rest of the wall, 3 or 4 feet in thickness, was of Rosendale cement. I wanted to get a perfectly solid, hard wall in the shortest possible time.

During the first winter, or before the entire completion of the dam, the intention was to keep sufficient water in the reservoir to entirely cover this concrete wall, so that there would be no freezing in it whatever, until it had a thorough chance to become hardened. As a matter of fact it was found very difficult to do that, as the nature of the stream was so violent it practically could not be done, and in the case of a heavy rain it would take so long to open three 36-inch gates that we were liable to have the flood come over the unfinished portion of the work, and consequently the gates were left open all winter. It was a mild winter, but there were quite a number of days when the frosts were very severe, and I had looked to see, perhaps, some possible defect in the outside portion of the concrete wall the next spring, but there was not any. Even the plastering was perfect, and I do not think there was any deterioration. I could not see that the frost had affected it at all. At the lower end of the same pipe wall I built the gate chamber of concrete, but en-

tirely of Rosendale cement. That was partially exposed during the winter, and that did crack, and we had to renew a certain portion of the outside. It showed me how efficient an outside covering of Portland cement is in a case of that kind, and it pleased me very much.

I will be pleased to answer any questions the members may ask.

DISCUSSION.

MR. FULLER. I would like to ask Mr. Taylor what the cost of this dam was.

MR. TAYLOR. I don't know precisely, but my impression is, something approaching $125,000.

MR. FULLER. How wide is the bank on the top?

MR. TAYLOR. The embankment on top is 12 feet in width; at the high water line, 40 feet. It was first designed to be 20 feet in width on top, but afterwards it was deemed best to carry it up two feet higher, so in case of high water, and when there should be an extremely high wind, it would prevent any washing over the top. The wall of the waste-way itself is only 5 feet in height, but the embankment is cut down 2 feet close to the roll-way.

MR. CHAPMAN. Will Mr. Taylor explain the cross section.

MR. TAYLOR. The main cut-off wall is extended some three feet below the main wall, and through this are laid the three lines of 36-inch pipe, the concrete extending, in every case, at least two feet below the bottom of the pipes, and in many places it was from 3 to 4 feet below, being of a very irregular character. The top line of the cut-off walls is at an elevation of 34 feet below high water. The four cut-off walls were 3 feet in width, and 3 feet in height, and extended into the embankment at least 8 feet. This pipe-wall was covered at least 3 feet above the top of the cut-off walls, the entire length, with clay puddle, enveloping the whole.

MR. BRACKETT. Where was the gate chamber?

MR. TAYLOR. The gate-chamber was at the lower end and the gates were placed at the lower end. It was open at the upper end, except that now one of the supply pipes has a stand pipe erected on it. When this was first designed, it was intended to build the supply pipes on a higher level, and have the gate chamber on the upper end, but I felt a little suspicious of the character of the rock, and also that it would be a saving of expense to utilize one of the three lines of the 36-inch pipe; at the same time it could be used as a waste-pipe.

MR. COOK. How much below the surface is the supply pipe?

MR. TAYLOR. That is to be 25 feet. The one that is actually put in is a flexible joint and the details about that Mr. Grannis could give you better than I can. It is not designed to draw more than 25 feet below the surface of the reservoir.

MR. COOK. Is it connected with floats?

MR. TAYLOR. It is not exactly a float. It is so connected as to be operated by hand by a chain and lever.

MR. HASTINGS. What is the core wall made of?

MR. TAYLOR. Made of concrete, one part Rosindale cement, two parts sand, and five parts broken stone. There were immense quantities of stone in the excavation, and a stone crusher was placed there, and the material broken with that. There were used throughout the foundation, and in different parts of the works, some hundreds of yards of Portland cement concrete, perhaps 500 or 600 yards, but most of the wall was of Rosindale cement concrete. The total height of the dam, from the top to the deepest point, is 75 feet. That experimental shaft was carried down 48 feet below the surface. A little further east the excavation is 33 feet.

NOTE.—The inlet, as built, did not have a flexible joint, as stated, but was a wrought iron stand-pipe, with gate openings at different elevations, the top being about 12 feet below the surface. L. A. T.

SOME EXPERIENCE WITH WATER HAMMER.

BY

E. E. FARNHAM, Superintendent, Sharon, Mass.

Some three years ago, the Water Company of this place were somewhat troubled by pounding in the pipes when the pump was running.

The pumping station is at the foot of a hill and practically at one end of the system.

Pumping is done direct through a 6-inch main to a stand-pipe, the distance from station to stand being about 1500 feet and the head 185 feet. The greatest trouble was at the end of a pipe that run at right angles to the main, between the pumping station and the stand-pipe.

Part of this pipe was 4-inch, part 2-inch and the service pipe into the house 1-inch. This latter pipe run to the top of the house and emptied into a tank, with a ball-cock on the end.

The distance from the pumping station to the end of this pipe in the house is about 2480 feet. At times the pounding in this house, as well as others on this street, was fearful.

The pipes fairly shook and the hose used outside for sprinkling was burst three times in one day from the shock. In another house the lead service pipe in the cellar was also burst.

An air chamber was put on the end of the inch pipe, near the ball-cock, in the house, and another outside the house in the street; neither of these seemed to have any effect on the noise. Finally it was decided to connect this line with another main to get a circulation.

About 520 feet of 2-inch pipe was laid, but before the ends were connected a remedy was tried which it was hoped would prove effectual.

Having no vacuum chamber on the suction pipe to pump, it was decided to put one on.

When the suction pipe was disconnected from the pump, in the water bot-

tom was found a stick about 10 inches long and an inch wide, worn smooth, and the ends rounded, it evidently having been in there for a long period.

The removal of this, together with the putting on of the vacuum chamber, was thought to be a sure cure, but it was not.

The pounding was still with us, although a little modified, and it was thought best to try something else.

Plenty of remedies were suggested and tried, but the result was the same.

Finally it was decided to put on a larger air chamber, but before this was done an arrangement was made so the air chamber could be kept nearly full of air, and this proved to be an effectual remedy.

The whole cause of the trouble, simple as it may seem, arose from the air chamber becoming filled with water, thus destroying the cushion.

The pounding was also heard on pipe, that had a free circulation from one main to another, but now as long as the air chamber is kept free of water we have no trouble.

I might add here that it was thought, if a little air was introduced into the suction pipe, at each stroke of the pump, it would find its way into the air chamber and crowd the water out; a nipple was tapped into the suction pipe near the pump, and a check valve placed thereon opening inward. At each stroke of the pump a little air would suck in. This scheme resulted in turning the air into the mains, so that when a faucet was opened the water drawn at first looked like milk, but after standing a minute or so it would clear itself of the air contained in it and resume its natural condition. There was so much comment made on this that it had to be discontinued.

DISCUSSION.

THE PRESIDENT. I have no doubt many members in the management of their works have had experience somewhat similar to what Mr. Farnham has had, and I would be pleased to hear from any of them. It is suggested that I should ask Mr. Gould if he has had any trouble of the kind on his works.

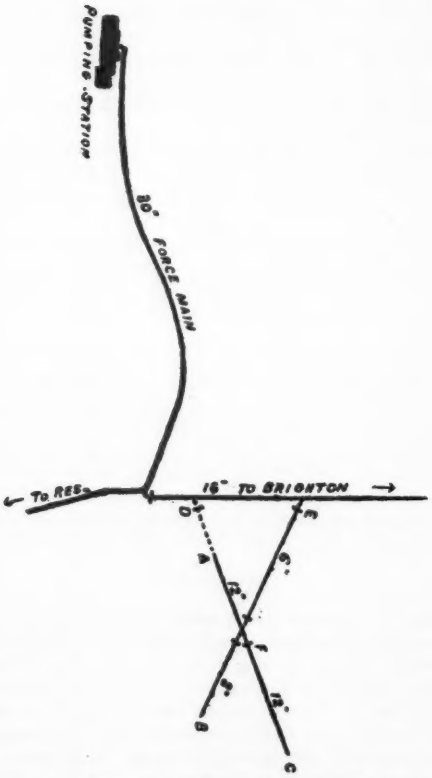
MR. GOULD. One of the most serious cases of water hammer that has occurred on the Boston Water Works for several years was remedied by simply connecting a "dead end" with the supply main. I can illustrate it, perhaps, on the black-board. (Drawing an illustration.)

A 30" force main connects Chestnut Hill pumping station with Fisher Hill reservoir. About 2000 feet from the pumping station a 16" pipe branches off to supply Brighton.

The street mains near this point had three dead ends, A, B and C, and were supplied from the 16" main by a single 6" connection at E.

The water hammer in the houses in this district was very severe, although no complaint was made on the line of the 16" main beyond this point. To remedy the trouble, the 12" pipe was extended from A to D, a distance of about 200 feet, and connected with the 16", which entirely removed the trouble, not only at A, but also at B and C.

One pecularity about this case was that the hammer closed the gate, an ordinary 12" valve, at the point F. I wouldn't believe it at first, but such I found to be the fact.



THE PRESIDENT. What kind of a gate was it, may I ask?

MR. GOULD. It was one of the ordinary Boston Water Works manufacture.

THE PRESIDENT. That is closed by a screw?

MR. GOULD. Yes.

THE PRESIDENT. Was that when the gate was wide open?

MR. GOULD. When the gate was wide open. There was probably enough play to the valve, so that every time the hammer occurred it worked a little bit on the screw, and gradually closed it.

MR. BRACKETT. I should say, Mr. President, that the reason why that, and perhaps some other remedies that are applied in such cases, are effectual, is very hard to give. I should say simply that this gives an illustration of what might prove as an effectual remedy in some other cases, for it did certainly work well there. Of course, every one has a great many dead ends on his

works where they give no trouble, but I have noticed in connection with our system that in some cases there is more shock or more water-hammer, at the end of a long line of mains, four or five miles distant from the pump, than there was anywhere else in the distribution. We had in one case a long line of pipe connected with the high-service system, which supplied a small territory, and there was at the end of that line quite a shock, not enough to make any great trouble, but still appreciable, and very evidently shown on a pressure gauge, which did not exist on any other part of the system, and it was simply the pulsation of the pump as we could read it on the gauge.

THE RISKS TAKEN BY A CITY OR TOWN IN HAVING BUT ONE SUPPLY MAIN.

BY

J. C. Hancock, Superintendent, Springfield, Mass.

Society, at the present time, is so organized that a system of water-works for our large towns and cities, is an actual necessity; it not only adds to our comfort, health, and consequent happiness and prosperity, but our very existence *as* a large town or city, depends, to a great extent, upon it. A good supply of wholesome water is one of the greatest blessings that can be bestowed upon a community; pure water has more inherent healing qualities than all the drugs in the universe.

When people become accustomed to having water run to their dwellings, workshops and mills, in abundance, for domestic, sanitary, manufacturing or fire purposes, nothing can induce them to give it up—it has become a necessary part of their existence, and to be deprived of it is not only a great inconvenience, but a great calamity. The shutting off of the water supply from a city for a day, or even an hour, means to many of the industries a cessation of business and a consequent loss of time and money. But the greatest danger of shutting off the supply of water, is from fire; no city can afford to be deprived, for an instant, of water for extinguishing fires. Upon this one point, at least, I think we are all of one mind.

If, then, water is so necessary, and the cutting off of the supply a calamity, certainly the city that has but one supply main is running a *risk*, in a greater or less degree, in proportion to the length and condition of this one main. The necessity of a well executed system of public water supply increases as the population increases, and as the mass of buildings grow.

Most cities have two or more mains from the source of supply, whether the system is gravity or pumping, but there are also many places that depend wholly on one. A main ten miles long is more liable to give out than one five miles in length; a strong cast-iron main, having a large factor of safety is a much more reliable conductor of water than one of sheet-iron lined with cement, but whatever the material, whether one mile in length or ten, there is a possibility, and in some cases a strong probability, that the main will sometime break, and the whole supply of water be cut off. Instances can be cited

by most superintendents where this has occurred, and the water been cut off for one or more days.

It quite often becomes necessary to shut off the water for the purpose of making connections; this is not as bad, of course, as to have the main break, as preparations can be made in advance for protection against fire.

A water supply should be constant, and it is a duty devolving upon all having water works under their charge, to do all in their power to make the supply an unfailing one. At least two mains should be provided for every city or large town, particularly if the distance from source of supply is a long one.

In my own city, (I am sorry to say), we have but one main from our principal reservoir. Should this main break, at least two-thirds of the whole territory covered, would be deprived of water entirely, as we have no other means of supplying this section. This main is twenty-four inches in diameter, and is made of sheet-iron, lined and covered with hydraulic cement; it has been laid seventeen years this summer.

Springfied is not the only city so situated. The city of Northampton, and the towns of Westfield and West Springfield, our near neighbors, have had experiences which they do not care to have repeated, from being deprived of water on account of breaks in their mains.

It would be much more agreeable to me to speak of the blessings that are sure to be showered upon a community which introduces an abundant supply of water—the protection it gives to life and property from destruction by fire —the convenience of having water run to our homes or work shops—what a willing sanitary agent it is, in removing waste and sewage from our places of abode—or of the living fountains shooting heavenward for blessings which they bring back to the pool at our feet,—rather than discourse on the dangers connected with a water system. But our feelings are not always the best guide for us to follow. It is the duty of all water works men, if they discover in their systems that which is liable to cause trouble, to point out the defect, that the city or town may apply a remedy.

I find, in looking over the large number of water-works reports received from all over our country, that works having pumping systems almost universally have their pumps and steam boilers duplicated, so in the event of one pump or boiler becoming disabled they have another to fall back upon—a precaution that is necessary and wise. So it should be with supply mains; they should be duplicated, so if one gives out we still would have another in reserve.

When we consider the vast interests dependent upon a constant supply of water, and the large amount of property that may be destroyed by fire, it convinces me that it is true economy to have our supply mains in as durable and safe condition as it is possible to make them.

I am well aware that there are places whose only dependence is upon one main, that have never been deprived of water for any great length of time; but this fact, (if it is a fact), is no evidence to my mind that all cities and towns should be content to do likewise. I know that water pipes do occasionally break and cut off the supply of water; I also know that two mains or two pumps are safer than one. I therefore unhesitatingly say that cities having

but one supply main are running great risks, and are not acting in accordance with the principles of true economy.

Because it costs money to duplicate our supply mains and pumping machinery, is a sufficient reason with many for opposing what they term the unnecessary expense, and the heavy burden it will place upon the municipality. I admit it is not pleasant to be heavily taxed or to carry heavy burdens; neither is it pleasant to run great risks, exposing ourselves and our property to loss or destruction by fire.

But let us look for a moment at this question of cost, and see if it is really so bad as represented. We will take for an illustration a city of fifty thousand inhabitants, and suppose the cost of duplicating their supply mains or pumping machinery to be two, three, or four hundred thousand dollars—sums startling to many members of city councils, particularly so if they desire re-election.

This money can be bonded at four per cent. interest, or less, by any live city, which would "burden" the people, sixteen, twenty-four, or thirty-two cents per capita per year, for the different sums named—a tax too insignificant to be compared with the benefits received from having an assured constant supply of water.

The value of a water system is very forcibly shown by the following, quoted from J. T. Fanning's "Treatise on Hydraulic and Water Works Engineering:"

"At Columbus, Ohio, the average loss by fire for the four years preceding the completion of the public water works, was $\frac{65}{100}$ of one per cent. of the valuation. The average loss during the first four years *after* the completion of the works was $\frac{13}{100}$ of one per cent., and during the fifth year, from April 1st, 1875, to April 1st, 1876, was $\frac{11}{100}$ of one per cent. of the valuation. These statistics show a probable saving in the first four years, of upward of one-half million dollars, and in five years of more than the entire cost of the works."

Again, in speaking of the advantages of a water supply, Mr. Fanning says: "In a recently adopted schedule of the National Underwriters, there are additions to a minimum standard rate in a standard city, which is provided with good water supply, fire alarm, police, etc., as follows, termed deficiency charges:

Minimum standard rate of insurance of a standard building		25 cts.
If no water supply	add	15 "
If only cisterns or equivalent	"	10 "
If system is other than gravity	"	05 "
If no fire department	"	25 "
If no police organization	"	05 "
If no building law in force	"	05 "

The financial value of the enhanced fire risk, as deduced by the Board from an immense mass of statistics, and the additional premium charged on the most favorable buildings, is 60 per cent. without good water works, and 40 per cent. if only fire cisterns are provided."

Water is the most effectual agent known to man for the suppression of fire;

we should have it in abundance and at all times. If any part of our works is in a dangerous condition, and the water supply liable to be cut off, a remedy should be immediately applied.

A constant supply of water is of too much importance to be ignored. We should keep on the safe side, and run no unnecessary risks.

DISCUSSION.

MR. RICHARDS. I think there is no question about the desirability of having two supply mains or a distributing reservoir, which takes the place of an additional main. But there may be a question whether the additional main would not cost more than the reservoir. And it should be remembered that the combined area of the two mains would have to be considerably larger than the area of one, on account of the increased frictional head; and, of course, two small mains will cost very much more than one large one. So it seems to me a question whether it would not be cheaper to build a distributing reservoir than to put in two small mains.

MR. W. M. HAWES. It is almost impossible to get up a discussion on a paper upon a subject on which we all must agree. Of course the object of our water supply system is very largely to protect us against fire, and we cannot have too many mains and too many means or ways of getting water readily on to a fire. But you have got to keep talking and talking and impressing it upon the people. It would help us a great deal in this matter if we could only educate people to keep their heads level when there is a fire. There is no time in the world when a man thinks he has so much right to lose his head, and sometimes he appears to lose his head and all his senses, as when there is an alarm of fire. They will think they have a perfect right to do some ridiculous thing they never would think of doing at any other time. A few years ago certain parties made a plan of our city streets and everything on them, a very handy little plan. Our superintendent had a hundred or hundred and fifty copies struck off, and had all the water pipes and hydrants marked on it, and they were furnished, part of them to the water department, and the larger part of them to the fire department, so that the firemen in their leisure hours could have an opportunity to study and familiarize themselves with the location of every hydrant, and would know what to use in case of a fire in any locality in the city. Twice certainly since then our firemen have gone to fires and connected three steamers on a 6-inch supply, when right around the corner, nearer the fire, was a 16-inch pipe to connect with. Within three weeks they did the very same thing, and one of the papers the next day said, "What is the matter with the water works that we can't get water for use at fires?" Blamed the Water Board, because the firemen lost their heads, and didn't know enough to go around the corner and connect on to a 16-inch pipe when the map was right before them all the time, to learn day and night, where the hydrants were so they could go to them. (Laughter.) If there is anything of that kind occurs they will usually lay it to the water department. So I think it is best to have two or three main supply pipes so the firemen can't make a mistake if they do get rattled and lose their heads. (Laughter.)

THE PRESIDENT. I would like to know if Mr. Taylor can give us any points on this question.

MR. TAYLOR. I am very much of the opinion of Mr. Hawes; it don't seem to call for much discussion. Mr. Hancock seems to have covered the ground pretty thoroughly. Of course it is a question of policy, as Mr. Richards has remarked, as to distributing reservoirs. If we can for a moderate amount of money have one or more distributing reservoirs right close to the city, it is better than to run an additional long main, very much better. It gives us with a smaller outlay for pipe lines a more adequate supply when we most need it. I had occasion only a little while ago to make estimates for a water works where the people were very much in favor of bringing the water from a long distance by gravity, and I found by putting in a distributing reservoir close to the town, and using a 10-inch pipe, it would give a better service than with a long line of 16-inch pipe, and the 16-inch pipe line would cost more than the entire system did under the plan carried out. Of course these things are matters to be carefully studied, and each system and each town must be carefully studied according to its own location. There is no doubt that either distributing reservoirs or duplicate pipe lines are not only much needed, but I might say that they are absolutely necessary, and as the system becomes older should be added to. I have recently designed a system with a distributing reservoir, first with one outlet from the reservoir, and later intending to attach two others for different parts of the town. Of course the exact method of delivering the greatest amount of water at the time of the greatest need is a study. In my opinion where it can be done, additional reservoirs are preferable.

OBITUARY.

F. FLOYD WELD—City Engineer, Waterbury, Conn., died June 28th, 1890, aged 40 years. Joined this Association, February, 1890.

BENJAMIN S. GRUSH—Superintendent of Water Works, Salem, Mass., died May 3rd, 1891, aged 72 years. Joined this Association, June 1884.

New England Water Works Association Membership Roll.

September 1st, 1891.

NOTE.—The secretary requests to be advised of existing errors or changes of address from that which appears in the following list.

ACTIVE MEMBERS — RESIDENT AND NON-RESIDENT.

Alexander, George
Commissioner of Public Works, Quincy, Mass.

Allen, Charles A.
City Engineer, Worcester, Mass.

Allen, Charles F.
Treasurer, Hyde Park, Mass.

Allis, Solon M.
Superintendent, Malden, Mass.

Andrews, Frank A.
Assistant Superintendent, Nashua, N. H.

Ayres, Henry W.
Chief Engineer, Hartford, Conn.

Babbidge, P. F.
Superintendent, Keene, N. H.

Babcock, Stephen E.
Hydraulic Engineer, Little Falls, N. Y.

Bacot, R. C., Jr.
Superintendent Meter Department, Hoboken, N. J.

Bagnell, Richard W.
Superintendent, Plymouth, Mass.

Baldwin, Charles H.
Box 2410, Boston, Mass.

Baldwin, Richard,
Proprietor Water Works, Terryville, Conn.

Ball, Phinehas
Civil Engineer, Worcester, Mass.

Bancroft, Lewis M.
Chairman Water Commissioners, Reading, Mass.

Barns, Everett
Superintendent, Westerly, R. I.

Barrett, Albert P.
Water Registrar, Woburn, Mass.

Barrus, George H.
Consulting Steam Engineer, 95 Milk street, Boston, Mass.

Bassett, Carroll Ph.
Civil Engineer, 784 Broad street, Newark, N. J.

Batchelder, George E.
Registrar, Worcester, Mass.

Battles, James M.
122 Webster street, East Boston, Mass.

Bayles, James C.
Hydaulic Engineer, East Orange, N. J.

Beals, Joseph E.
Superintendent, Middleboro, Mass.

Belcher, J. White
Water Commissioner, Randolph, Mass.

Bickford, Nathan B.
Superintendent Water Works, O. C. R. R., Boston, Mass.

Billings, William R.
15 Harrison street, Taunton, Mass.

Birkinbine, Harry
Civil Engineer, Wayne, Delaware County, Penn.

Bishop, George H.
Civil Engineer, Middletown, Conn.

Boggs, Edward M.
Hydraulic Engineer, Banning, California.

Bolling, Charles E.
Superintendent, Richmond, Va.

Brackett, Dexter
Assistant Engineer, City Engineer's office, City Hall, Boston, Mass.

Brainard, C. M.
Treasurer, Skowhegan, Maine.

Brinsmade, Daniel S.
Civil Engineer, Birmingham, Conn.

Broatch, J. C.
Superintendent, Middletown, Conn.

Brown, A. E.
Assistant Superintendent, Quincy, Ill.

Brown, Arthur W. F.
Registrar, Fitchburg, Mass.

Brown, Edward H.
Superintendent Nevada County, N. G. R. R., Grass Valley, Cal.

Brown, J. Henry
3 Tremont street, Charlestown, Boston, Mass.

Brown, Milton A.
Superintendent, Perth Amboy, N. J.

Brush, Charles B.
Engineer and Superintendent Hackensack Water Company, 1 Newark street, Hoboken, N. J.

Bucknam, Geo. A. P.
Superintendent, Norwood, Mass.

Burnham, Albert S.
Superintendent, Revere, Mass.

Burnie, James
Superintendent, Biddeford, Me.

Butler, J. Allen
Superintendent, Portland, Conn.

Caldwell, Joseph H.
Registrar Mystic Division, Charlestown, Boston, Mass.

Carroll, F. B.
104 Pequot av., New London, Conn.

Chadbourne, E. J.
Superintendent, Holbrook, Mass.

Chandler, Charles E.
City Engineer, 161 Main street, Norwich, Conn.

Chandler, Charles F.
Professor of Chemistry, School of Mines, Columbia College, New York city.

Chaplin, W. S.
Professor of Engineering, Harvard University, Hammond street, Cambridge, Mass.

Chace, George F.
Superintendent, Taunton, Mass.

Chase, H. S.
Superintendent, Great Falls, N. H.

Chase, John C.
Superintendent, Wilmington, N. C.

Childs, Wm. H.
Superintendent and Secretary, Manchester, Conn.

Clark, D. W.
President Water Company, Portland, Me.

Clark, Ezra
President and Superintendent, Hartford, Conn.

Clark, Jonas M.
Superintendent, Northampton, Mass.

Clifford, Walter
New Bedford, Mass.

Coburn, Walter
19 Congress street, Lowell, Mass.

Cochran, Robert L.
Superintendent, Nahant, Mass.

Codd, William F.
Superintendent, Nantucket, Mass.

Coffin, Freeman C.
Assistant with M. M. Tidd, 10 Tremont street, Boston, Mass.

Coggeshall, R. C. P.
Superintendent, New Bedford, Mass.

Conant, H. W.
Superintendent, Gardner, Mass.

Conant, Whitney
Secretary Water Co., Long Branch, N. J.

Congdon, John L.
Superintendent, East Greenwich, R. I.

Cook, Byron I.
Superintendent, Woonsocket, R. I.

Crandall, F. H.
Superintendent, Burlington, Vt.

Crehore, Dr. C. F.
Box 1252, Boston, Mass.

Crilly, P. F.
Superintendent, Woburn, Mass.

Crockett, A. F.
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Croes, J. J. R.
Civil Engineer, 13 William street, New York city.

Cunningham, W. B.
Superintendent, Trinidad, Col.

Cushing, Lucas
Assistant Superintendent, 710 Albany street, Boston, Mass.

Darling, Edwin
Superintendent, Pawtucket, R. I.

Davidson, James
Superintendent, Box 342, Central City, Colorado.

Davis, Charles S.
Water Commissioner, Plymouth, Mass.

Davis, F. A. W.
Vice-President Water Co., Indianapolis, Ind.

Davis, William E.
Superintendent, Sherburne, N. Y.

Dean, Francis W.
Mechanical Engineer, Exchange Building, 53 State street Boston, Mass.

Dean, Seth
Civil Engineer, Glenwood, Iowa.

Decker, J. H.
86 Liberty street, New York city.

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A MARVELOUS TEST.

NEW YORK, June 8, 1891.

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DEAR SIR:—We have had the pleasure of furnishing your Department during the past ten years about 5,500 Crown Meters. In the last shipment of 50 ½ Crown Meters furnished you, we sent five of our "A" style of Crown Meter. We write to ask you if your Department has tested any of that lot of meters, and, if so, will you kindly send us a copy of such test?

Yours very truly,
JOHN C. KELLEY, President.

[COPY.] DEPARTMENT OF PUBLIC WORKS.

ROBERT E. SMITH, Commissioner. COMMISSIONER'S OFFICE, CITY HALL,
JOHN C. KELLEY, Esq., President National Meter Co., Providence, R. I., June 11, 1891.
252 Broadway, New York.

DEAR SIR:—Your request of the 8th inst., for a copy of the test for accuracy of a ½ Crown Meter, "A" pattern, is received. Inclosed find copy of the test of meter No. 84,169.

Yours respectfully,
ROBERT E. SMITH, Commissioner.
By W. F. SLADE, Secretary.

Test for Accuracy 1-2 inch Crown Meter No. 84,169, "A" Pattern, March 31 and April 2 and 3, 1891.

WATER PRESSURE.	FAHR.	TIME.			METER.	TANK.	OUTLET. Brown & Sharpe Disk.	PER CENT.
		Hours.	Minutes.	Seconds.				
70 lbs.	70 Deg.	..	4	..	10 feet.	623 lbs.	$\frac{1}{2}$ in.	.0
70 "	70 "	..	7	23	10 "	617 "	$\frac{1}{4}$ "	0.8
70 "	70 "	..	30	5	10 "	618 "	$\frac{1}{8}$ "	0.9
70 "	70 "	..	22	20	2 "	124 "	$\frac{1}{16}$ "	0.4
70 "	70 "	1	13	20	2 "	127 "	$\frac{1}{32}$ "	1.9
70 "	70 "	2	43	..	2 "	126 "	$\frac{1}{50}$ "	1.2
70 "	70 "	3	23	..	1 "	64 "	$\frac{1}{75}$ "	2.7
70 "	70 "	5	50	.	1 "	64½ "	$\frac{1}{100}$ "	3.5

WHAT DOES THIS TEST SIGNIFY?

One Cubic Foot of Water on 1-2 inch Stream was Registered in 24 Seconds.
" " " " $\frac{1}{100}$ inch " " 21,000 "

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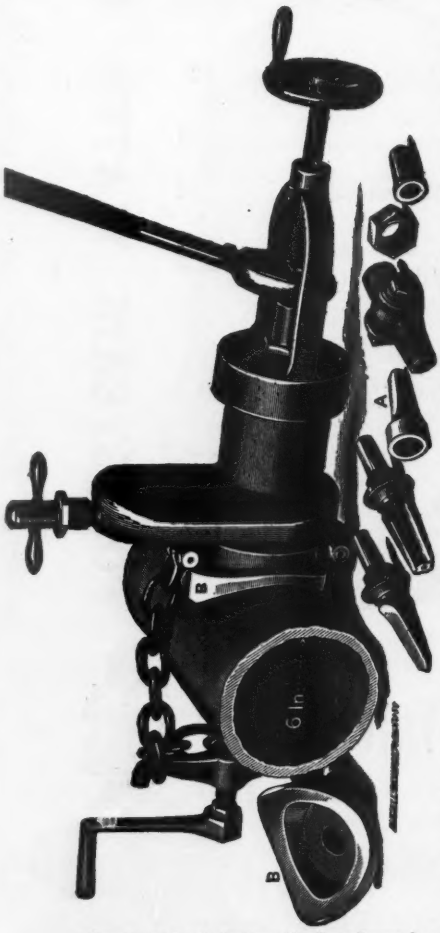

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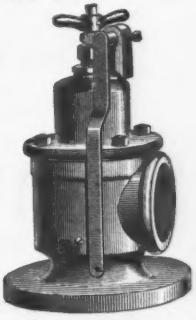

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Total, - -	4,535	"	"

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Whole Number Sold, 17,000.

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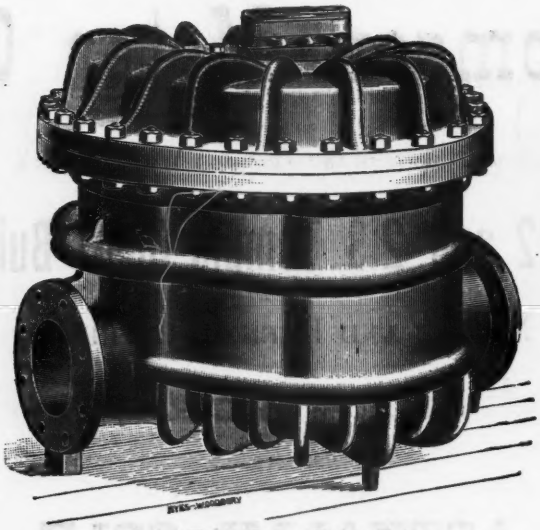

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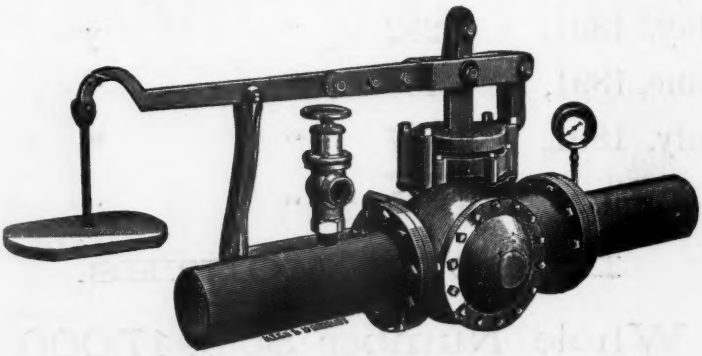

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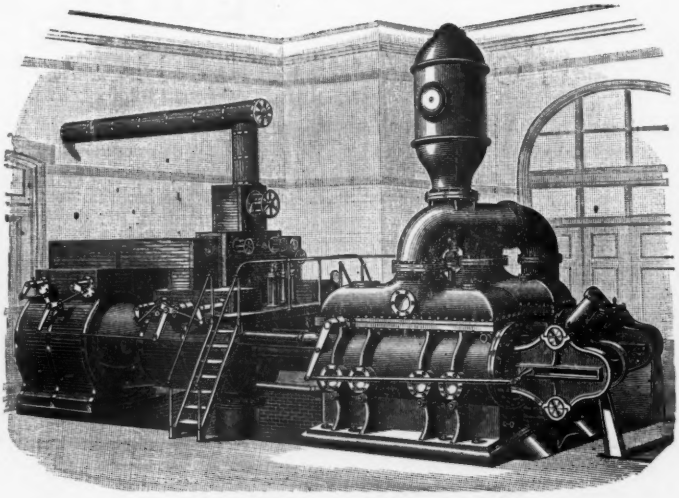

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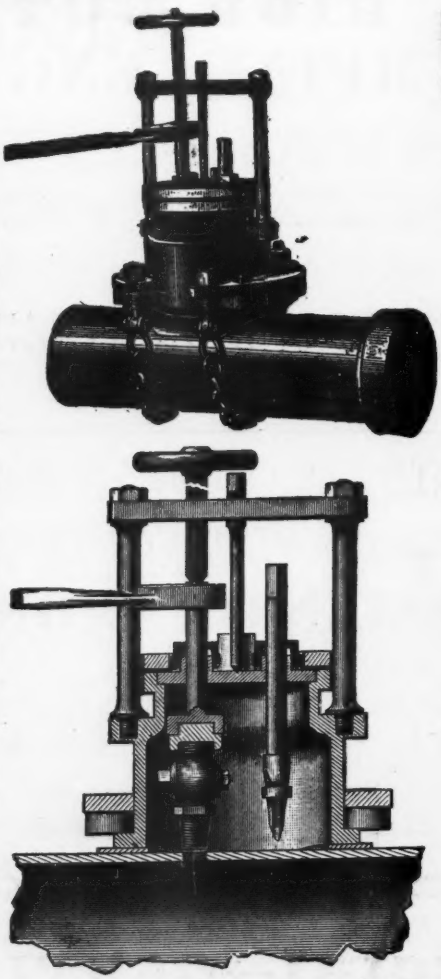

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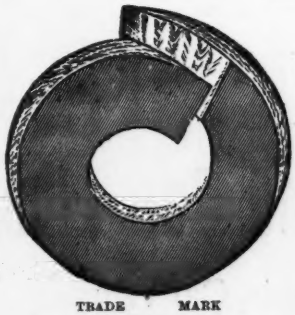

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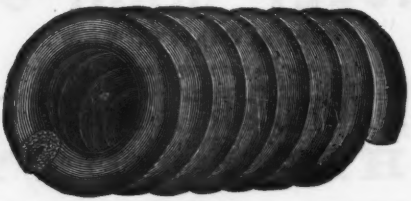

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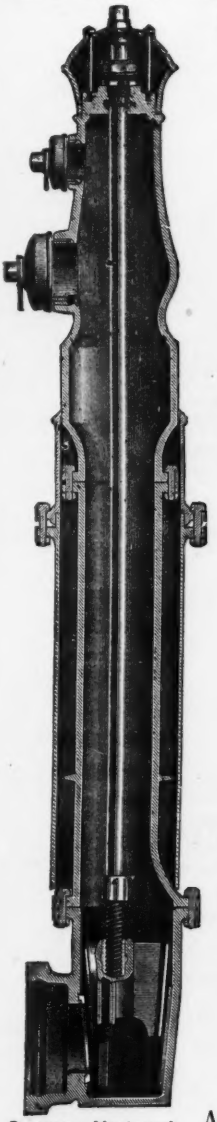

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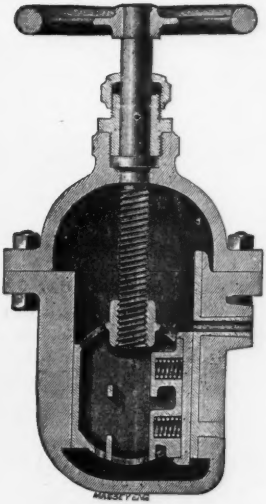

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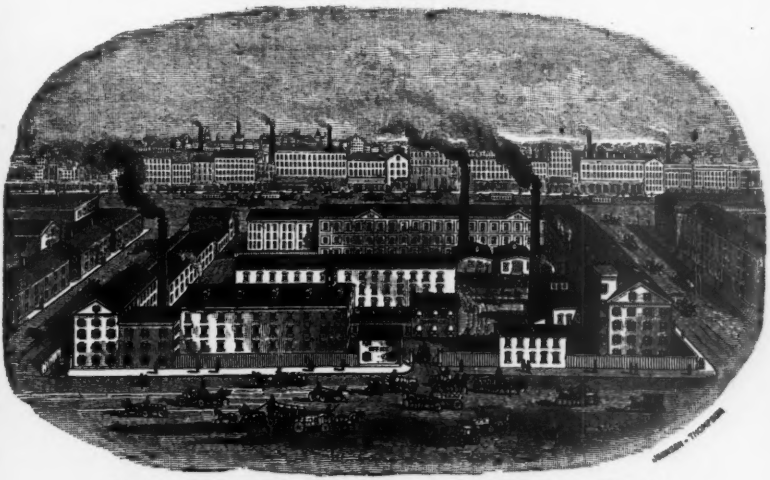

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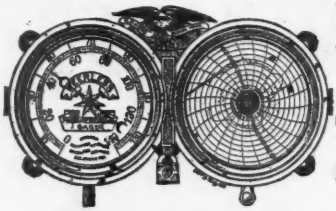

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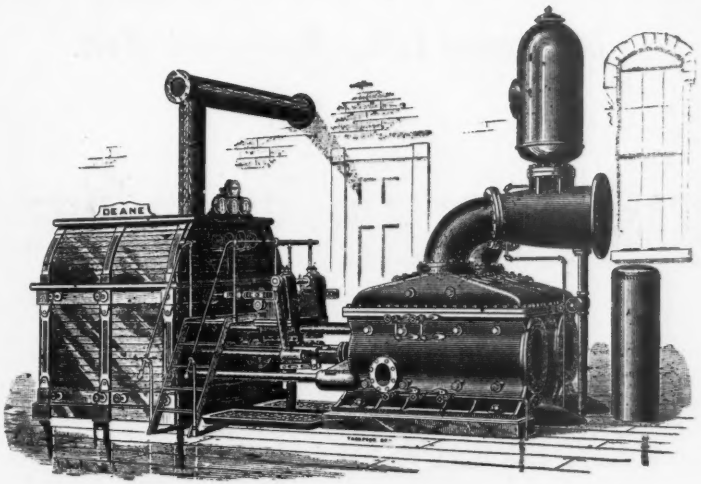

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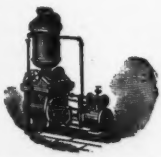

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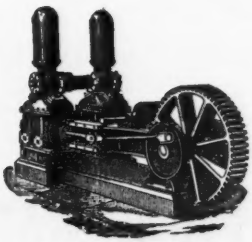

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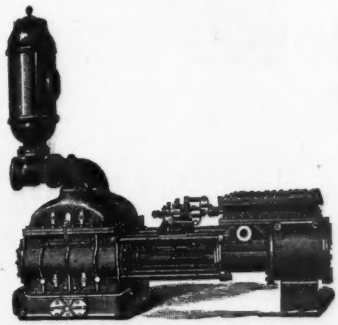

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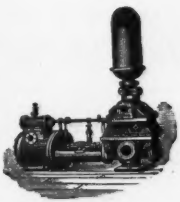

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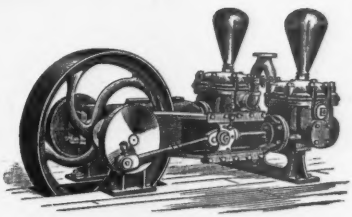

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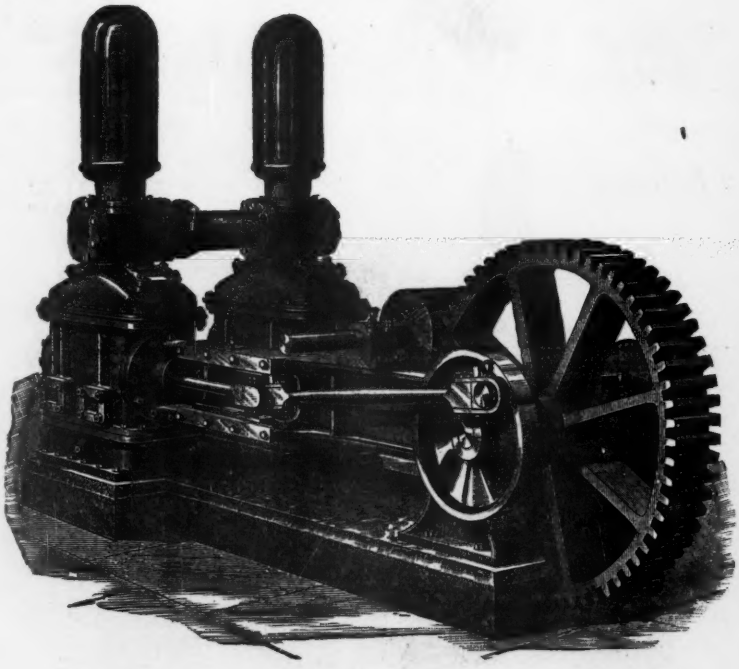

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The Journal of the New England Water Works Association

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